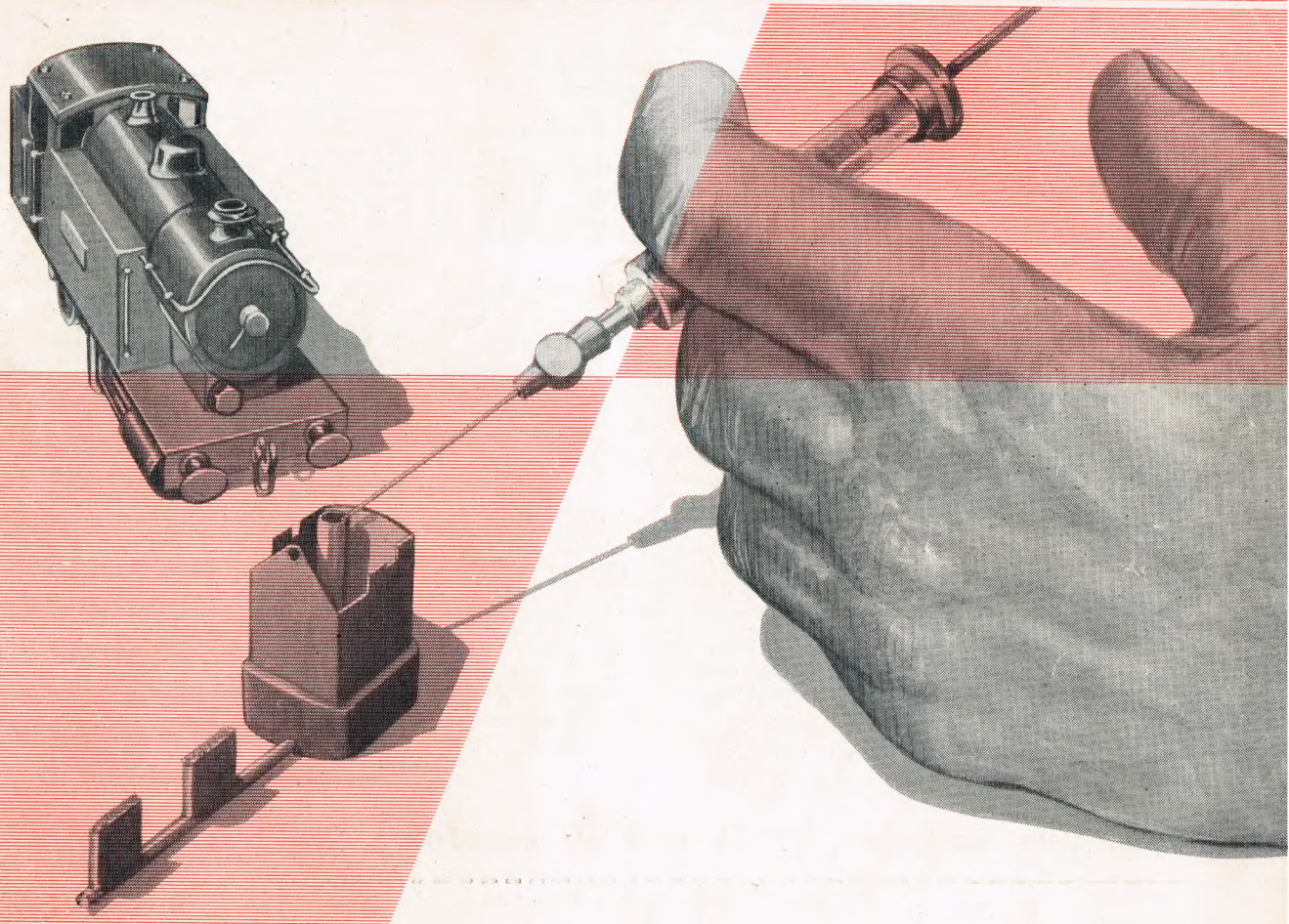
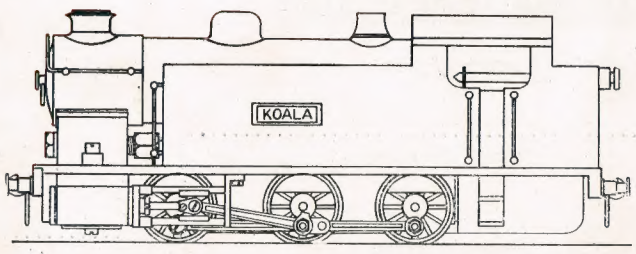
Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED



WORLD'S SMALLEST STEAM LOCOMOTIVE



ONE SHILLING 31 OCTOBER 1957 VOL 117 NO 2945

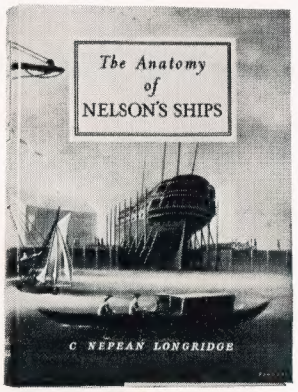
MORE SHIP MODELLING BOOKS

THE ANATOMY OF NELSON'S SHIPS *by Dr. C. Nepean Longridge.* Describes the construction of the ships of the Nelson period with drawings and the only existing photographs showing the hull construction of two of the ships which actually fought at Trafalgar. Gives a complete description of the masts, spars and rigging of H.M.S. *Victory* and tells of how the author built his important model of her. A series of five large scale folding plates, showing both hull and rigging, complete what is undoubtedly a most comprehensive and reliable book. 272 pages. **63s.**, post 1s. (U.S.A. and Canada $12.50, post paid).

SPRITSAIL BARGES OF THAMES AND MEDWAY *by Edgar J. March.* The history of stumpie, river, coasting, mulie and ketch barges, the details of their construction, the full story of the Sailing Matches and famous racing barges, together with complete plans and instructions for making miniatures of these picturesque craft. This delightful book, beautifully produced on antique paper, with art inserts in two colours, will have a wide appeal. **30s.**, post 1s. 9d. (U.S.A. and Canada $6.00, post paid).

PERIOD SHIP MODELLING *by R. K. Battson.* Constructional notes with 65 diagrams on the making of a model Elizabethan galleon. This book is primarily for those who have made a start on this fascinating hobby and wish to acquire greater skill and knowledge. The pitfalls that await the beginner are numerous, but this book will help the modeller to avoid them. **3s. 6d.**, post 3d. (U.S.A. and Canada $1.00, post paid).

MODELLING TUDOR SHIPS *by R. K. Battson.* The author's third and most ambitious book devoted to ship modelling. Surveys development in ship building and the establishment of the Navy on a permanent basis. The construction of the built hull is fully detailed, and together with "Period Ship Modelling" and "Ship Modellers' Workshop," the modeller will obtain complete information on his art. 88 pages, 50 illustrations. **4s. 6d.**, post 3d. (U.S.A. and Canada $1.25, post paid).



SHIP MODELLERS' WORKSHOP *by R. K. Battson.* 82 pages, illus. In this book by the author of "Period Ship Modelling" the reader has at his disposal the experience gained in the author's 25 years of amateur and professional ship-modelling. The book is arranged in alphabetical order under the headings of component parts, and under each heading the modeller will find advice and guidance on the best and most effective means of producing the components in either modern or period style. **3s. 6d.**, post 3d. (U.S.A. and Canada $1.00, post paid).

SHIP MODELLERS' LOGBOOK *by John N. C. Lewis* 200 pages. A valuable introduction to lightweight ship modelling written especially for the beginner. After providing some essential background information on the various types of museum ship model and the evolution of the sailing ship through the ages, the author gives practical building instructions for a series of models, among them a decorative half model and a sailing model of a Grand Banks fishing schooner. The book is illustrated with many photographs of the models or the ships described and with 14 accurate scale plans. In addition, there are over 100 detailed drawings by the author. **7s. 6d.**, post 9d. (U.S.A. and Canada $2.00 post paid).

THE MERCHANT SCHOONERS *by Basil Greenhill.* In two volumes, **60s.** the pair. Postage 2s. 0d. (U.S.A. and Canada $12.00, post paid.) Volume II can be purchased separately, price **30s.** postage 1s. (U.S.A. and Canada $6.00, post paid).

The period 1870 to 1940 is covered. The author tells how, why and where the schooners were built, how they were launched, equipped and manned, in what trades they were employed, the nature of the voyages, the speed of their passages and the reasons for their decline and inevitable end.

VOL. I is in two parts. Part I is an historical summary of the schooner trade and a detailed account of the method of building, illustrated with diagrams and drawings and some of the very few builders' plans in existence. Part II gives an account of those vessels that sailed from ports in the West Country. Vol. I is illustrated with over 70 photographs and many drawings and plans by David R. MacGregor and Roger Finch.

VOL. II contains a detailed account of the men who sailed the schooners and the sort of life they lived. A chapter on "Design and Management" explains the inter-linked story of the design of the ships and the way they were financed and run. There is also an account of the schooners from eastern and southern England. Part 2 of this volume is given over to a detailed study of the decline of the small sailing ship and the history of the development of the small auxiliary motor sailing ship. This volume contains the drafts, deck, spar and sail plans of the schooner *Rhoda Mary* and the ketch *Hobah*, and the drafts of the ketch *Clara May* all drawn by David R. MacGregor, It also contains a sail-maker's spar plan of the schooner *William Ashburner*, numerous drawings by Roger Finch, and over 60 plates.

MODEL YACHT CONSTRUCTION AND SAILING *by Lt.-Col. C. E. Bowden A.I.Mech.E.* New enlarged 4th edn. Explains how modern knowledge of hydrodynamics can be applied to the design of small racing craft with dramatic results. Numerous illustrations. **5s.**, post 3d. (U.S.A. and Canada $1.25, post paid).

From your bookseller, or by post by completing Order Form below

M.E. DETACH ALONG DOTTED LINE

POST THIS TODAY

Please supply by return of post

.....
TITLE OF BOOK

.....
TITLE OF BOOK

I enclose remittance value £ : : d.
to cover postage and packing.

To Percival Marshall & Co. Ltd.
19-20, Noel Street, London, W.1

NAME (Mr., Mrs., Miss).....
BLOCK LETTERS PLEASE

ADDRESS.....

.....

.....

(Overseas customers can use an International Money Order)

"LICKHAM HALL"

4-6-0 HALL CLASS LOCO in 3½-in. G.

Designed by "L.B.S.C."

Comprehensive Lists (6d. stamp) contain details of blueprints and castings for many "L.B.S.C." designed small steam loco's; Workshop Equipment, etc.

Blueprints, 12 sheets ...	42/- set
Frame, steel	9/9
Buffer Beam angle ...	2/8
Buffer Beam castings ...	5/- set
Main Horns, pressings	10/6 set
Main Axleboxes ...	12/- set
Frame Stays	2/9 ea.
Bogie Bolster	6/9
Bogie Centre	8/-
Bogie Axleboxes ...	5/- set
Bogie Spring Pockets ...	2/- set
Bogie End Stays ...	4/6
Cast Grate, iron ...	3/-
Conn. and Coup. rods	8/3 set
Cylinder castings ...	67/6
Guide Bar brackets ...	3/-
Eccentric Straps ...	6/9 set
S/B Door and Ring ...	13/6
Chimney	5/3
Saddle	8/9
Tender frame steel and buffer beams ...	7/2
Tender Horns & Springs	15/9 set
Tender wheels ...	12/- set
Tender axleboxes ...	15/6 set
Tender hand pump ...	4/6
Boiler former plates ...	12/6
Reverse lever stand ...	8/6
Crosshead pump ...	3/-

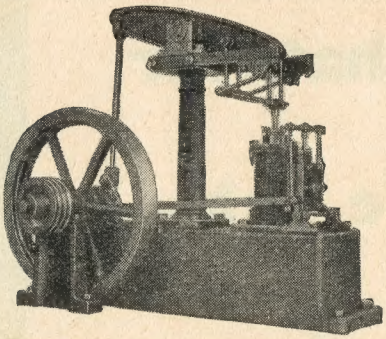
Postage extra.

"THE CHOICE OF EXPERIENCE"

A. J. REEVES & CO. (Birmingham) LTD.

416, MOSELEY ROAD, BIRMINGHAM, 12

Telephone: CALthorpe 2554



Why a BEAM ENGINE?

Because it is a fascinating engine to watch in motion. Every moving part (except the Slide valve) can be seen and Watts' Parallel motion is of never failing interest. Because it runs slowly, it only needs a quite small boiler. It is one of the Simplest engines to build.

Complete set of castings and all materials

£3 17s. 6d.

Including postage & Purchase Tax £5

Abroad: there is no Purchase Tax

Our catalogue is **1s.** post free.

STUART TURNER LTD

HENLEY-ON-THAMES, OXON

A GOOD IDEA

is worth a lot more than the price of our big catalog —You'll Find The Catalog FULL of Good Ideas . . . Plans . . . Parts . . . Tools for the Live Steam Rail Roader.

Send 50c. to

LITTLE ENGINES

Box K, Lomita, California, U.S.A.

PRECISION GEARS

64 D.P. RANGE — BRASS

TEETH	O.D.	EACH	TEETH	O.D.	EACH
12	.223"	2/9	48	.781"	5/6
16	.281"	3/3	60	.969"	6/3
20	.344"	3/6	64	1.031"	6/6
24	.406"	3/9	72	1.156"	6/9
30	.500"	4/-	84	1.344"	8/3
32	.531"	4/-	96	1.531"	9/-
36	.593"	4/3	100	1.594"	11/3
40	.656"	4/9	120	1.906"	12/-

SEND FOR COMPLETE LIST. PHONE 20231-2

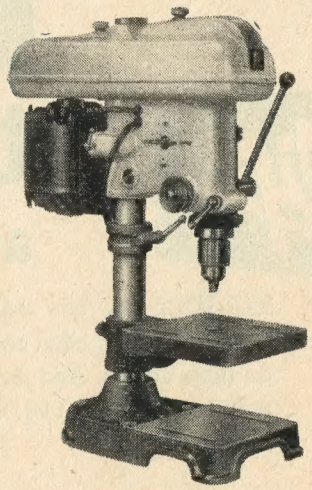
100 Types — *S. H. Muffett, Ltd.* — 16-100 D.P.

PRECISION PRODUCTION ENGINEERS

Mount Ephraim Works, Tunbridge Wells

BUCK & RYAN Ltd

TOOL MERCHANTS



FOBCO DRILLING MACHINE

0-½" capacity

For 220/240 £40·18·0

For 400/440 £38·12·6

Mortising attachment £6·7·3

Vice £5·2·6

CREDIT TERMS AVAILABLE

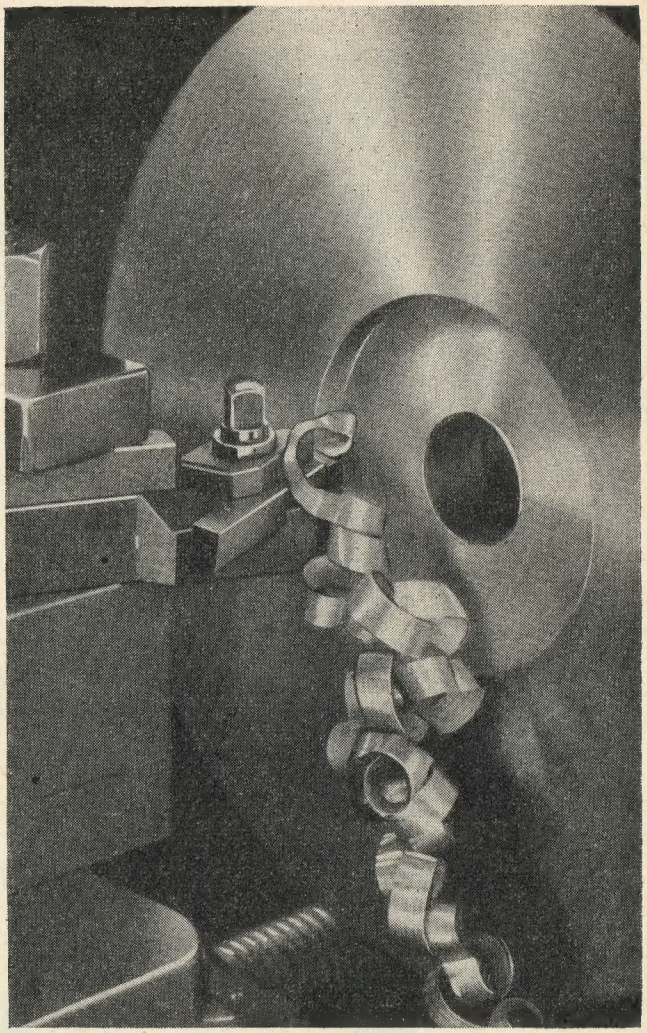
Leaflet on request

We always have in stock, a wide range of equipment for the model engineer

310-312, EUSTON ROAD, LONDON, N.W.1

Tel. EUSTON 4661

Whatever the job - - -



you're safe with

Eclipse

tool bits
and tool holders

ECLIPSE tool bits are made from H3 Cobalt High Speed Steel. They hold their edge under the most severe conditions. You can rely on them always. And they are at their best when used with ECLIPSE tool holders—the tool holders that make sure the tool bit is held immovably.

'Eclipse' tool bits, tool holders and other tools are made by James Neill & Co (Sheffield) Ltd., and are obtainable from all tool distributors

UT8

Model Engineer

ONE SHILLING 31 OCTOBER 1957 VOL. 117 NO 2945

Published every Thursday Subscription 58s. 6d. (USA and Canada $8.50) post free

In this issue

595 Smoke Rings
597 Live steam in OOO gauge
602 Steam car design—I
605 Beginner's workshop
606 The regattas
608 A rule holder for marking-off
610 Locos I have known—45
612 LBSC
615 An American Virginia
616 Cross-drilling jig
618 Power for model boats
621 Postbag
624 Drill from scrap
625 Readers' queries
626 Club news

Next week

ME gauge 1 steam locomotive—part 2
Sentinel agricultural tractors
Pedestal type tool grinder
Traction engine rallies
Safety on the line
Myrmidon—conclusion

The Editor is pleased to consider contributions for publication in MODEL ENGINEER. Manuscripts should be accompanied by photographs and/or drawings and should have a stamped addressed envelope for their return if unsuitable. None of the contents of MODEL ENGINEER may be reproduced without written permission. All correspondence should be addressed to the Editor, Model Engineer, 19-20 Noel Street, London, W1.

Smoke Rings

A WEEKLY COMMENTARY BY VULCAN

AS soon as Moscow announced the New Moon of October 4, the radio-astronomers of Cambridge rushed to action stations. For the twelve young men in Martin Ryle's team this was the most thrilling and privileged weekend of their careers. Taken by surprise like the rest of the world, they worked in shirt-sleeved haste to track the satellite as it swung round and round the earth. One moment it was off Land's End, the next it was over Cambridgeshire !

While the general public—except perhaps for the space-minded schoolboys—had at best only a very vague understanding of radio-astronomy, or the reception of signals from outside the world's atmosphere, readers of MODEL ENGINEER already knew a good deal about it from " The Way To The Stars " in the issue of June 7 last year when a remarkable bowl-shaped radio-telescope appeared on the front cover.

Abreast of events

They had also seen a picture of a tracing on a recording milliameter, the method used at Cambridge for tracking the Khruschev Comet—rather appropriately in red ink.

To this extent our readers were on the spot. And so was the craft of modelling. Not only are the radio-telescopes built up experimentally from models, but the satellite itself existed on earth only in model form. While it circled our planet and was still known to us only as a radio noise or a speck of light in the heavens, a model in Prague revealed its shape and substance for the first time.

Seldom had a model, or a photograph of one, been studied by so many with such interest.

Encyclopaedic

REGULAR readers will know by now that the MODEL ENGINEER family is a complete work of reference. Ask almost any question in Postbag—from the speed of earth-bound satellites to the price of socks in Bloemfontein—and someone is bound to pop up with the answer.

For example, F.N.M.'s query on the subject of Allan valve gear (Readers' Queries, September 26) has drawn a response from A. H. Jacker, of Richmond, Surrey, who points out that the relevant data and equations are given in *Valve and Valve Gear Mechanisms*, by Prof. W. E. Dalby.

Mr Jacker goes on to make the generous offer that he could supply F.N.M. with photostat copies of the LNWR application of the gear, providing it is not needed in too great a hurry. What do you say, F.N.M. ?

Frank D. Woodall, of Shipley, Yorks (an ideal spot for a ship enthusiast ?), comes up with the information sought by R. C. Roberts on the

Smoke Rings . . .

subject of lake steamers (Postbag, September 12).

The full story, he says, of the Windermere steamers was told in *Cumbria* issues of January and February, and a comprehensive account, embracing Ullswater and Coniston as well, was published recently by *Sea Breezes*.

And about the *Gondola*, Mr Woodall states that two models of it exist, built by a former captain of the vessel; one is owned by British Railways, the other is in private ownership.

Recently, coloured pictures of the *Gondola* have decorated the carriages of British Railways.

Now here is another chance for the fellows with the answers. A. C. Rattle, of Coalpit Heath, near Bristol, is in search of information. "I wish to construct a non-working detailed scale replica of a 3 in. naval gun of the type in use as deck armament on submarines during the last war," he says.

If anyone can supply the necessary gen I will be glad to pass it on.

The Bulleid Pacifics

PERHAPS the most controversial class of locomotive ever to be put on rails in recent years, the Bulleid Pacifics are in the news again. Fifteen of the West Country, or light Pacifics, are now being rebuilt by British Railways under the supervision of Mr W. J. A. Sykes, chief mechanical and electrical engineer, Southern Region.

I think most readers will agree that, although the class has acquired a doubtful reputation as regards economy of coal and oil, the West Country type has put up many fine performances.

These locomotives were introduced in 1945 and were a lightweight version of the Merchant Navy type, 104 being built at Brighton and six at Eastleigh.

Most of the modifications made are very similar to those on the rebuilt Merchant Navy class; a new inside cylinder has been provided together with three independent sets of Walschaerts valve gear, the cylinders remaining at 16⅜ in. × 24 in. Maximum valve travel for the outside piston valves is 6¼ in. and for the inside valve 6 11/32 in.

The oil bath, one of the unusual features of the original locomotives, has been dispensed with, and the steam reversing gear has been replaced by a manual arrangement, shaft operated from the cab.

A new smokebox, of cylindrical shape, has been fitted and this, together with conventional but very low chimney and dome casing, has improved the outward appearance considerably.

It will be interesting to see how the rebuilt locomotives behave on the track. I shall not be surprised if they prove to be very successful in service.

Churchward anecdote

AT the annual luncheon of the Institution of Locomotive Engineers, Mr R. F. Hanks, chairman, Western Area Board, British Transport Commission, related an anecdote of the great G. J. Churchward. Mr Hanks was a boy at Swindon at the time when Churchward was the presiding genius there, and he said:

"I have the proud record that during my whole time at Swindon I was never spoken to by the great man, I never spoke to him and I was never under the same roof with him ! I worshipped the man who created *The Great Bear* and the Stars, and the Saints, and I was determined to get some sort of photographic record of him.

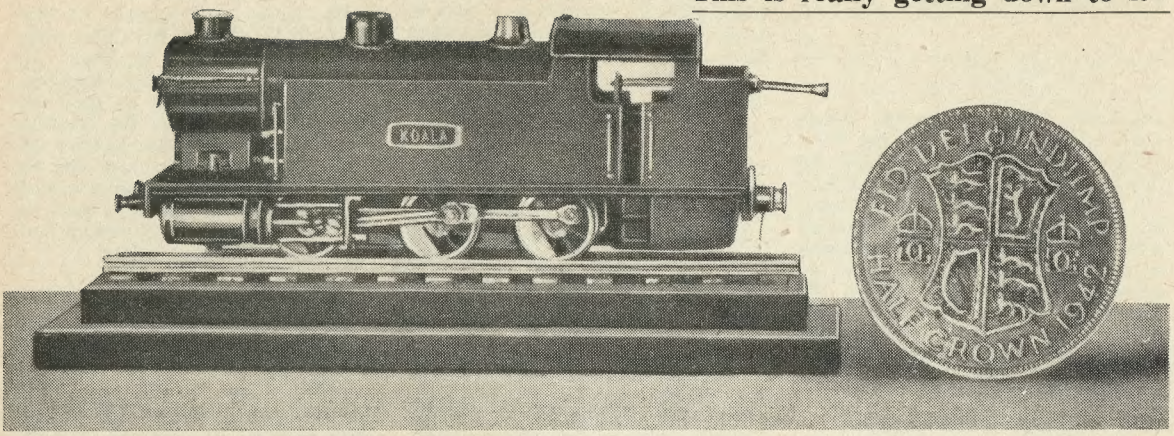
"One day, therefore, knowing his route between his house and his office, I hid behind an engine and waited for him to pass, and when he had passed I popped out and clicked my camera.

"It was a back view, but I am distinguished amongst all you engineers by being the only man in the world probably who has a picture of the great G. J. Churchward running tender first ! "

Cover picture

Filling the tiny fuel tank of the OOO gauge 0-6-0 *tank locomotive* KOALA, *the smallest working steam locomotive in the world. A. A. Sherwood, of Sydney University, Australia, who built this engine, describes its construction on pages* 597 *to* 601. *Inset shows the engine actual size.*

For 70 years the Fintona Horse Tram has provided a service between the town and the railway junction. Now the last tram, driven by William McClean, whose father also drove the tram, has travelled the half mile track which was a part of the Great Northern Railway's Enniskillen-Omagh service. Dick, the horse, will go into retirement, and the tram will go into Belfast Transport Museum



Live steam... IN OOO GAUGE!

By A. A. Sherwood

THE OOO gauge 2 mm. scale live-steam locomotive described in this article is, at the time of writing, the last of a series of miniatures I have made. Many of these have been described in the pages of MODEL ENGINEER over the last dozen or so years, including the first OO gauge 0-6-0 tank made in 1945, which is very similar in general design to the subject of this article.

During 1951 I made my first attempt at live steam in OOO gauge; at that time the problem of getting a simple pot boiler to work in this size was not solved successfully; the final result (which was shown at the ME Exhibition of that year) was a 2-6-2 tender locomotive, with the boiler fired by a petrol blowlamp in the tender.

It would function after a fashion, but the erratic performance of the internally-fired boiler compared very badly with the smooth and constant output of the pot boiler on the OO gauge 0-6-0 tank. Nothing further was done about the matter until the present year, when the fact that the OO gauger was still running beautifully 12 years after its production made me reconsider the OOO gauge problem.

The result this time was much more successful. The name *Koala* was suggested by the local small bear and as a contrast to the Great Bear, Ursa Maximus, and the like.

GENERAL DESIGN

In a model of this type, the desirable features are, in order of importance: (*a*) large side tanks; (*b*) high pitched boiler of moderate diameter; (*c*) small driving wheels; (*d*) not more than two leading wheels; (*e*) no trailing wheels; (*f*) outside cylinders; (*g*) inside valve gear.

The reasons are: (*a*) to form a "firebox" of adequate volume; (*b*) for adequate height of flame above the wicks; (*c*) large drivers would extend into the side tanks and prevent "flame spread"; (*d*) clearance for the rear wheels of a pony truck is restricted on an outside cylindered locomotive; (*e*) trailing wheels would obstruct the fuel tank; (*f*) inside cylinders would require inside connecting rods and obstruct the wick tubes—even if one could get two cylinders *and* valves between frames $\frac{5}{16}$ in. apart; (*g*) the type of valve used acts as a safety-valve and condensate clearer as well, and could not be made to look like the full-size counterpart without great difficulty.

As far as I could determine, no such prototype exists, so a freelance design is indicated at the start. Furthermore, experiments with small lamps showed that the fewer the number of wicks, the better. Hence, the best solution seems to be an 0-4-0 tank.

The only snag here is that the wheelbase would have to be so long to get all the required heat from one wick that the result would almost look like *Koala* with the middle wheels missing—to put it politely, definitely not acceptable. So the best functional solution is out on grounds of appearance; this is often the case in designing models (or small locomotives or even toys, whichever designation the reader prefers).

The next choice was an 0-6-0. Preliminary designs seemed to indicate that the minimum length would be about 3 ft more than the longest British 0-6-0 tank ever constructed (to scale, of course). It would have been possible to produce an 0-8-0 tank within scale length, but since this would require three burners, the final choice was the 0-6-0.

It is to be hoped that the length does not appear too excessive to the many who set great store by the proportions of the steam locomotive; to shorten the locomotive, it would be necessary to reduce the capacity of the fuel tank (and also the length of run per filling) and/or shorten the pistons (and reduce the working life of the locomotive considerably).

It is very definitely not desirable to produce a locomotive of scale weight; in fact the model locomotive of very small size should be made as heavy as possible. *Koala* weighs a scale 200 tons, or about 2 oz. actual.

MAINFRAMES

These are 0.015 in. brass—as thin as practicable to leave the space between them as wide as possible. The bearings for the middle and rear

axles are phosphor bronze tubes, which also act as spacers; the front buffer beam is also integral with the frames in one silver soldered assembly.

The frames are fixed to the running boards by four 1.0 mm. screws on each side. To counteract the weakness caused by the cut-away to clear the cylinder block, the thickness of the frames is double in this region. The whole frame assembly is quite rigid when attached to the running boards, which are of 0.04 in. brass plate.

WHEELS AND AXLES

The wheels (salvaged from the offending 2-6-2 locomotive) are of stainless steel 0.35 in. dia. with a 0.046 in. crank throw. They are press fitted on 0.0625 in. hardened steel axles.

Hardened steel crankpins are fitted to the centre and rear wheels, the front crankpins are cheese headed screws, as the clearance here is rather restricted. The other crankpins are fitted with 0.8 mm. hexagon nuts to retain the coupling and connecting rods.

COUPLING AND CONNECTING RODS

These are of stainless steel, fluted and bushed with bronze at the bearings. I would say that they are the most irksome parts to make, as they are not easy to grip without damage during the final operations. In order to obtain free running, some work with a fine needle file was necessary to correct the centre distances of the coupling rod bearings.

I seem to recall a statement that coupling rod end bearings are given about $\frac{1}{16}$ in. clearance in full-size practice. This corresponds to 0.0004 in. in this size and I wouldn't claim the fit to be as good as that in the case of *Koala*.

The knuckle joint on the central boss is a dummy; since the wheels are not sprung, there is no purpose in a working knuckle joint here. The small end of the connecting rod is tapped 0.8 mm. thread, and the wrist pin screws into it.

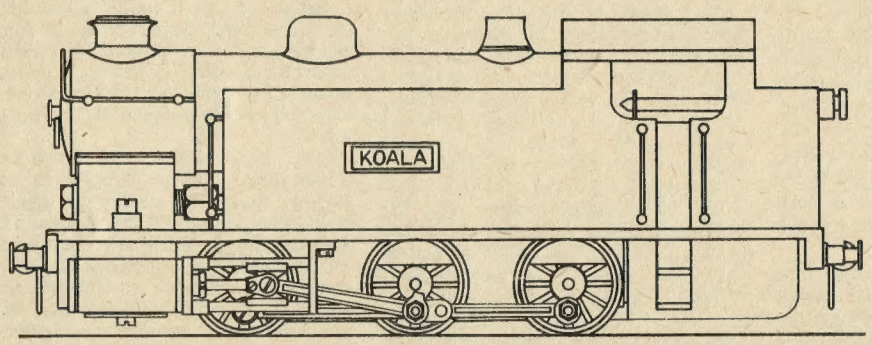
VALVE GEAR

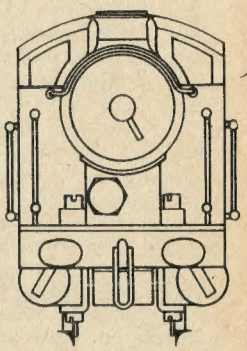
The valves are operated by slip-eccentric gear, the valve travel being 0.038 in. The two eccentrics are machined in one piece, and hardened; these are a running fit on the front axle. On each side of the eccentric assembly there is a stop collar; one is set for forward operation and the other for reverse. The eccentric rods and straps are of hardened steel, as are also the pivot screws which connect them to the slide valves.

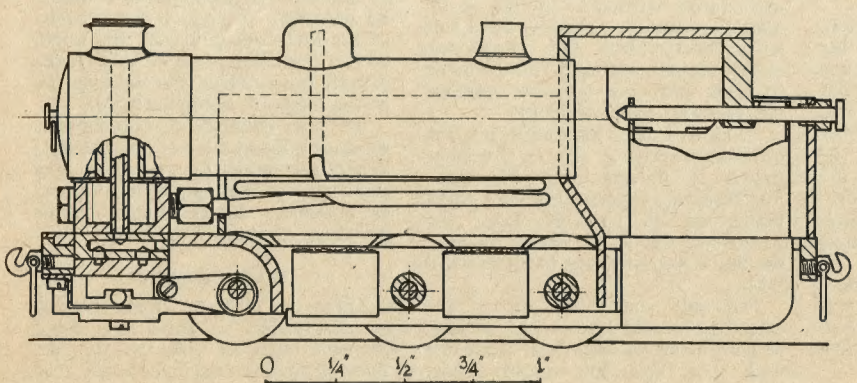
CYLINDERS AND VALVES

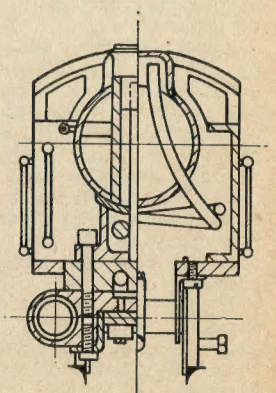
The cylinder block is based on the very successful design used on my first OO gauge steam locomotive.

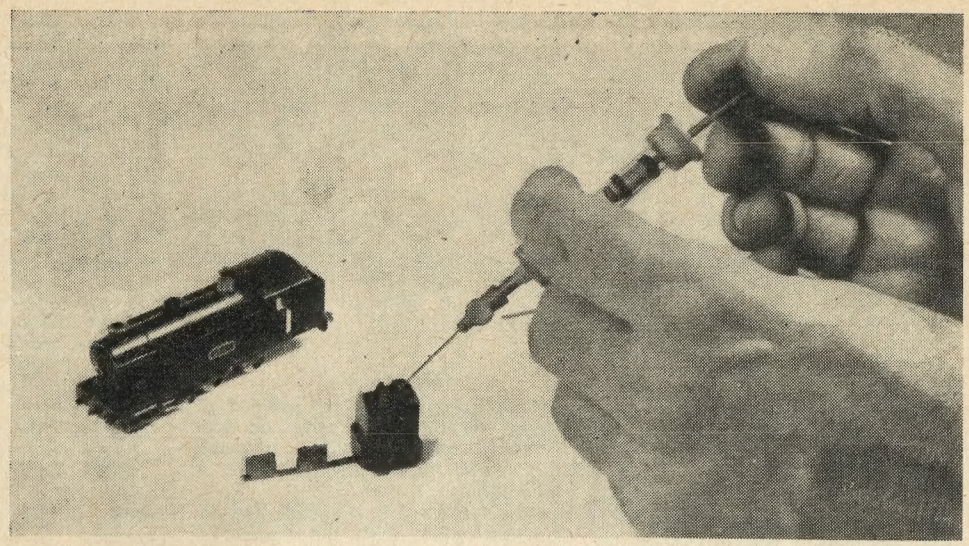
Briefly, it has the following salient features: (*a*) minimum number of parts required for complete cylinder block assembly (no studs or nuts involved, and no external pipe work required); (*b*) no valve chests required (the slide valves are spring loaded, and, therefore, function as safety-valves and condensate clearers (i.e. drain cocks) in addition to providing steam distribution); (*c*) the design enables the valve gear to be driven from the front axle without having











Filling the tiny fuel tank of KOALA

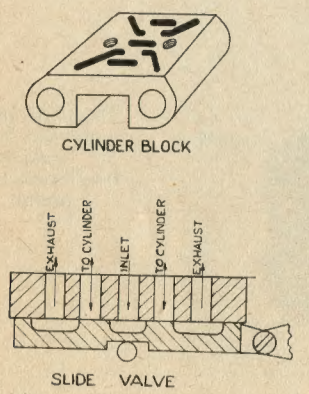
the eccentric rods so short that angularity errors would spoil the valve events.

The cylinder block is of brass, machined from the solid. All ports and steam passages are machined in the block, either as drilled holes or open channels, closed on assembly by a plate interposed between the cylinder block and the smokebox saddle.

Cylinder liners are of hardened steel, ground externally to a heavy press fit and then finish lapped internally after assembly. The back covers, which are fitted with the normal type glands, are press fitted to the cylinder block and soft soldered.

Slide-bars, which are circular in section, are press fitted into the back cylinder covers. The front covers are screwed 5/32 in. × 60 t.p.i. and actually hang on by a little over one complete turn of thread.

The cylinders look a bit overlong but, since the pistons are almost a full diameter long, this is unavoidable. Short pistons would very soon wear and leak badly, even when made of hardened steel. The pistons are of composite construction, consisting of an outer rim of hardened steel, and an inner hub of brass.



The hub was left overlength for chucking purposes, and cut off after the piston had been ground and lapped, and the piston rod hole drilled all at the same setting. The piston rods are 1/32 in. dia. stainless steel; press fitted in the pistons and secured to the crosshead by a setscrew.

Crossheads are also of stainless steel, and single sided to give clearance for the coupling rods. The slide valves are of phosphor bronze; their action should be evident from the diagram. The intended setting is: admit on dead centre, cut-off at 120 deg. past dead centre, and " line-for-line " exhaust.

These settings were obtained by drilling the valve cavities right through undersize, and then opening out with needle files until the setting was found to be correct when examined under magnification. A final check was made on compressed air, and then the backs of the cavities were plugged.

I have found a cut-off of 120 deg. to be about the best for very small locomotives; otherwise the performance at drag speeds is very jerky; I would far rather see a model locomotive crawl with a heavy load than romp along at an apparent scale speed of some hundreds of m.p.h., with the motion work just a blur.

The valves are held to the portface by means of phosphor bronze strip springs, with 0.05 in. dia. rollers interposed to eliminate frictional losses. The cover plate above the cylinder block has drilled passages which lead exhaust steam into the pipe communicating with the chimney, and take the inlet steam from the base of the smokebox saddle to the centre port of each row on the portface.

The pinhole ports and long steam passages would be hopeless on larger models; but in this size the steam velocity is so small that losses of pressure due to passage resistance are quite negligible—it is unfortunate that losses due to other causes are proportionately enormous; the percentage of heat lost due to the poor area-volume characteristics of small models is very high.

SMOKEBOX SADDLE

This has quite a respectable volume, due to the high pitched boiler; hence it is used as a displacement lubricator. The main part of the saddle was machined from solid brass, and the central tube and upper plate silver soldered in. The filler cap shown in the photograph is one of three used; when running, a plug is used which restricts the passage between the oil reservoir and the steam pipe to a very small area; after a run, a plug is inserted which isolates the cylinders from the boiler.

This plug is hollow, and oil is introduced through it into the cylinders to prevent corrosion. Then, this plug is replaced by another, which also isolates the cylinders from the boiler, but this one is solid, and so retains the oil in the smokebox saddle and cylinders, and prevents any oil getting into the boiler.

BOILER

This is a plain brass pot about $\frac{7}{16}$ in. dia. × $1\frac{3}{4}$ in. long; it was actually machined from the solid. The dome is $\frac{1}{4}$ in. dia. and is func-

tional. The "safety-valve" is actually just a filler cap with a 3/32 in. hexagon socket for the operating key.

The boiler is located in a hole in the front plate of the cab, and held down to the smokebox saddle by the chimney, which screws on to the exhaust pipe projecting from the top of the saddle. The steam pipe is 3/64 in. dia. hypodermic tube, about 4½ in. long, which, being exposed to the flame, acts as a steam drier or superheater—probably the former.

This tube is rather difficult to silver solder to brass, as the silver solder would much rather adhere to brass than stainless steel. The four handrail knobs are screwed into two brass tubes silver soldered across the smokebox. As there is very little room for a spanner to connect up the steam union, this is connected up before the boiler and smokebox saddle are fitted to the rest of the locomotive.

RUNNING BOARDS AND SUPERSTRUCTURE

This, the largest single item in the model, is a silver soldered brass assembly, made as heavy as practicable.

The part of the footplate supporting the coal bunker is reduced to very thin cross section to minimise heat conduction to the fuel tank. For the same reason, the cab roof is made of 0.007 in. brass foil—it looks much thicker, as the edges are turned down.

LAMP

The fuel tank was beaten out of a piece of 0.01 in. brass held over a former to obtain the rounded corners which reduce its apparent size and greatly improve the external appearance.

The fuel tank is surmounted by an open topped tank for cooling water. The only contact between the lamp and the rest of the locomotive is at the top of this cooling tank, so heat conducted to the fuel tank has to pass through the walls of the cooling tank first.

The steps to the cab are fixed to the fuel tank, and form convenient "handles" for holding the lamp when inserting it into the locomotive. The two wick tubes are the normal simple type, and are packed with cotton wick.

ORNAMENTS

Under this heading are included all items which have no effect on performance but are desirable to make the model look something like a locomotive.

The buffers are elliptical, and in stainless steel, with the bodies of brass with a square flange against the buffer beams. The hooks are of stainless steel, with pivoted shackles.

The three chain links sometimes seen on model hooks are an abomination in use—the links always seem to get tangled up when trying to couple up the train quickly because the locomotive has got steam up before it was expected—this has often occurred on these small jobs, as I usually start with hot water and steam is up in well under a minute.

The handrail knobs have 0.031 in. dia. balls, drilled 0.016 in. for the handrails and the shank threaded 1 mm. dia. The smokebox door handle is screwed directly into the front of the boiler, which is thick at this point due to the external "dished" shape. The guide bar supports are also dummies, and actually just clear the bars, which are adequately supported at their front ends, but they look rather queer with the rear ends unsupported.

The nameplates are of brass, with raised letters; they were pressed out with a steel die cut on an engraving machine with reversed type. This was the only part of the job not done in my private workshop.

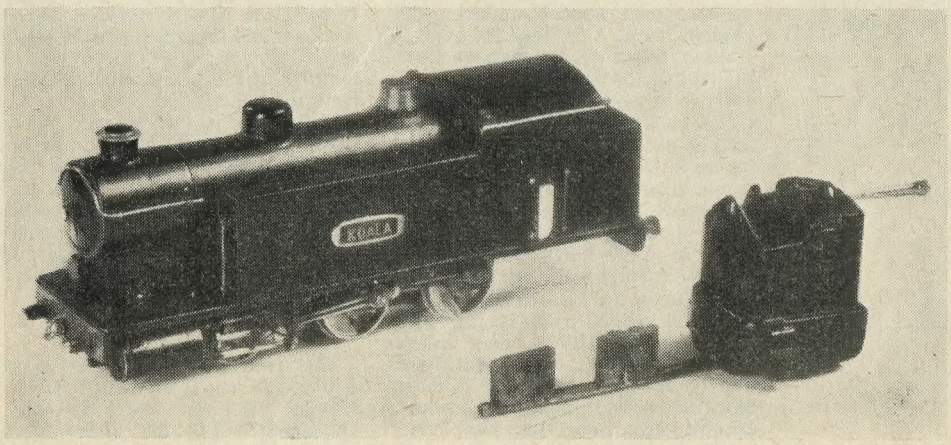
All brass parts without silver soldered joints were finished by chemical blacking. This gives a much better finish than paint (at least, it does in my inexperienced hands) but could not be applied to the major components as the chemical does not affect silver solder.

These components were finished in dull black enamel and stoved at high temperature (gas oven, Regulo No 3). The cylinder block was particularly troublesome, as such a temperature would draw the temper of the liners; consequently this item was stoved at a lower temperature for a much longer time. The buffer beams are finished in red, as in normal British practice.

TESTS AND PERFORMANCE

The foregoing details and diagrams describe the locomotive as in its present and final state. During the course of its development, however, there have been many alterations. The chassis, in substantially its present form, was first tried out with a superstructure having much smaller side tanks, and a lamp with one wick tube only. The motion was carefully set to run smoothly and start in any position on air pressure; the pressure of the spring controlling the slide valves was reduced to the practical minimum.

Attempts to run the locomotive on steam while jacked up were not a success, as insufficient steam was generated. Replacing the lamp by a small gas blowpipe cured the shortage of steam but, as the blowpipe flame could not be directed at the steam pipe, the steam was very wet.



The spirit lamp extracted from the miniature 0-6-0 *tank locomotive*

The second wick tube was then added to the lamp, and a few good runs obtained with the wheels jacked up. Then the first track runs were attempted. Fortunately, I had by me half a dozen full boxes of matches; I still had to learn the technique of getting the lamp into the locomotive without putting the flame out.

The first three trials were hopeless; just a slight tendency could be felt to propulsion under its own power. Then four laps were achieved without a stop on a 4 ft dia. circle. The relapse then set in; after much examination, it was found that the coned union on the steam pipe was leaking.

At this time, the steam pipe consisted of one turn of $\frac{1}{16}$ in. dia. brass tubing. When this had been repaired, improvement was rapid, and 15 laps of the circle were achieved without stopping. At this stage, the poor quality of the track put an end to tests as, at any speed above a crawl, derailments were frequent.

The performance was promising; in fact it was already a great improvement on the previous 2-6-2 tender locomotive. The existing track was improved as far as practicable, but it was not possible to make a really good job of it. A few more trials were then made and on one occasion 30 laps were made in about eight minutes, running light. There was no success at this point with load hauling, but there was a pleasing capability of being able to run at a very slow speed without stalling.

It was then that I decided to make a really substantial track, and also make a few modifications to the locomotive. New, and larger, side tanks were fitted, and the lamp shown in the drawings was made.

In order to improve the dryness of the steam, the single turn of $\frac{1}{16}$ in. steam pipe was replaced by two turns of 3/64 in. pipe. The early tests on the new track were not very good; two friends who came round to watch did not see more than three laps covered without the locomotive having to stop for shortage of breath.

After they had gone, I tried it out backwards—what a difference ! Forty laps were run and the speed was very much higher. Load hauling was then tried, and with 3 oz. (over 300 tons scale) load and in reverse the best performance was 56 laps.

Double this load could be hauled, but the track had to be wiped very frequently to prevent wheel slip. In forward gear, the performance was much poorer; at any speed above a crawl, the self induced draft put the flame out.

Trials with different fuels gave an interesting result. Methyl alcohol made the performance much livelier, and the flame was stable in forward gear at high speed (about $1\frac{1}{2}$ m.p.h. = 220 m.p.h. scale). The only snag was that fuel was exhausted in about half the time. The valve settings in reverse and forward gear are so nearly the same that the difference in performance cannot be due to this cause.

The last modification was to increase the height of the side tanks to the present dimensions. The performance is still better in reverse, but running in forward gear is now reasonable. Thirty-five laps have been achieved with a 3 oz. load; this time the fuel tank was not replenished before starting the locomotive off, i.e. the water was brought to the boil by the same charge of fuel.

When the 56 laps in reverse were covered, the fuel tank was refilled just before the locomotive was pushed off.

In order to hold the locomotive when hot, a handle was made. This has two recesses to fit over the front buffers, and a spigot which engages the hole in the chimney, and it is very convenient when the rather ticklish job of inserting the lamp has to be done.

One final comment. For me, this locomotive is the end of the quest for the moment in live steam. I may make other locomotives, perhaps even of the same gauge and scale, but anything below that size in live steam is beyond my capabilities. ▣

SOMETHING NEW IN LOCOMOTIVE TRIALS

MODEL locomotive trials of one type or another have been held by various model engineering societies, and they have almost always attempted to prove the efficiency of one locomotive against another.

The formulas used have been various and no doubt great fun was obtained by loading huge masses of sand on to trolleys and measuring minute quantities of coal and water, but whether they have proved anything scientific is open to grave doubts. The only definite things obtained were a headache for the slide rule operator and backache from those who loaded the trolleys.

At a meeting of the Welling and District MES it was suggested and agreed to make a complete break from tradition and run a locomotive trial for the fun of the thing without thought of proving locomotive efficiency. Needless to say the suggestor was not a locomotive man but a well-known power boat figure, to wit one J. G. Slender. The scheme is similar to that used in car rallies and is a pure test of skill on the driver's part.

Three markers are used, one at the start and two at the stop. The locomotive and driving trolley under test are positioned so the start mark is in line with the *rear* buffers of the trolley. The two other markers are positioned at the finish position and are placed one train length plus 2 ft apart.

The trial is a pure speed one in effect; after the ready is given the driver has to reverse past the start marker until the front buffers are behind it, then drive forward and come to rest between the stop markers. Timing starts from the time the rear buffers of the train pass the start line and ceases when the train comes to rest between (and clear of) the two stop marks.

This sounds very simple and it is so, but it can be very entertaining. For the Welling trials the long straight track of J. and E. Halls (Dartford) MES was borrowed on Sunday, September 29, for the afternoon and for those who know not of it, the track is a 500 ft dead straight track permanently laid along one side of the sports field and is complete with air operated turntables and sidings with air laid on. A very nice track, a very nice location and welcome old friends as hosts.

The track has a rise towards the centre and this added to the fun. The locomotive used (only one as it was decided to put all the drivers on a level footing) was a 5 in. gauge Maunsell U class 2-6-0 built and owned by F. A. La Roche, and thanks are due to him for allowing his machine to be so used.

Two runs were allowed for each driver. The markers were approximately 120 yd apart and it was noticed from observation of a speedometer fitted on the driving cars that peak speeds were in the region of 15 m.p.h.

The following are the six best runs in order of finish: J. A. King, 25.6 sec.; V. Lambert, 28.0 sec.; F. A. La Roche, 29.2 sec.; J. Chubb, 31.3 sec.; J. G. Slender, 33.0 sec.; G. Perry, 50.0 sec.

The event was such a success that the vice-chairman, B. H. Cousens, has donated a cup, which will be for annual competition.

INVICTA.

A STEAM CAR DESIGN

G. W. McARD presents the first of a short series of articles for those contemplating building their own steamers. The design, he claims, is one which will invite serious consideration by motor manufacturers

It is a curious fact that after 50 years' intensive development of the internal combustion engined car, the machine in which steam is the operating force is still regarded by many expert automobile engineers to be the finer of the two, notwithstanding the push-button control to which the former machine so admirably lends itself.

Later in these notes it will be shown that steam also can be designed to use this method of control, but the true measure of this machine does not lie in what may rightly be regarded as incidentals, as in the marvellously silent and flexible drive, high power with lively operation, and ease of control on the road. Within the past 12 months two-pedal control for throttle and brake have become optional on a number of i.c. engined cars for an extra charge, yet this control is one which the steamer has always possessed.

Tyres, which are an important item in the cost of motoring today, should have twice the life on the steamer of that experienced by i.c. owners, with 60,000 to 65,000 miles as an easily attainable limit for a motorist who uses his car intensively, but drives on the throttle and not the brake.

Maintenance of the i.c. car used to be a relatively simple affair for the owner-driver, but today the assemblage of its engine and auxiliaries (with all the etceteras) under the bonnet is so crowded as to make it inevitable that more and more of the repair jobs shall go to the local garage. The moral? Readers who plan building steam cars will avoid overcrowding their components; by so doing access to each unit will be improved, and a longer life per unit, and per car, will be assured.

The foregoing remarks prompt the question: what are the leading points to bear in mind throughout the development of your design? Remembering that you are planning to produce a car which will spring into life on the flick of a switch, I should expect you to aim for and combine in every detail *a* simplicity of construction, *b* sound mechanical design and *c* the finest materials for the purpose; also to ensure the longest mileage between refilling of water and fuel tanks.

The opinion held by many automobile engineers in the USA is that the steamer lends itself to high output methods equally with its rival, with the added advantage of a lower overall production cost per unit. Another aspect concerns the life of a first-class steam car. This has been put at 50 years. Now this is a big claim, a claim that even an enthusiast like myself might query but for the fact that Dobles are still running after close on 40 years' service, with an average annual mileage around 10.000.

The steam machine derives a longer life through the smoother operation of its engine and the entire absence of vibration; in the i.c. car vibration, which at times can be very uncomfortable, is entirely due to the explosive form of power production, and can only be overcome by costly expedients such as a multiplicity of cylinders, each with a less fierce explosive charge, and the provision of a gearbox which, with its several changes, permits a smaller engine to be used (and, therefore, a still smaller explosive action) by multiplying the torque delivered to the rear axle. But the increased initial cost of the car, plus its higher charges for lubrication and maintenance, are undeniable.

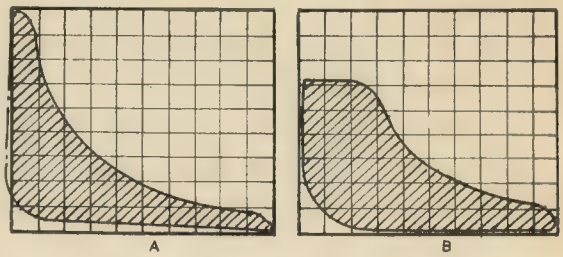


Fig. 1: Graphs of i.c. engine power stroke and the steam car engine at 50 per cent cut-off

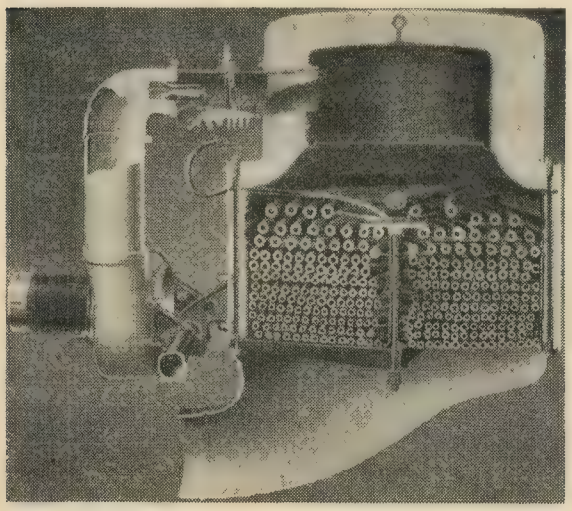


Fig. 2: The Doble monotube steam generator

Briefly, the five chief assets possessed by a good steam car are:

1 Flexibility of power unit, with reserve power always sufficient for any emergency that may arise.

2 Evenness of torque. This is best illustrated by the graphs in Fig. 1, showing at *A* that for the exploded charge in an i.c. cylinder and at *B* the graph for the steam as it expands in the cylinder.

3 Silence of operation. The only sound heard in the car is the hum of the burner and the impact of the tyres on the road surface.

4 Simplicity of transmission. If the gearbox and clutch are dispensed with this feature becomes even more pronounced.

5 Low maintenance costs. This will, to some extent, hinge on the thoroughness with which the design is executed and the workmanship.

Mr Doble's motto—The Best is Not Good Enough—is worth recalling here. But the low revving of the steam engine under most conditions of running obviously goes far to minimise maintenance charges.

I now propose to put forward those units which I would personally recommend when discussing engines and boilers, rather than discuss the many different types of each which are available.

Some readers with limited capital resources will want to " arrive " with the minimum of expense and time by using a small power outfit adapted to suit an existing chassis—a very understandable attitude—while the more ambitious enthusiast with generous financial reserves and plenty of opportunity will prefer a higher-powered top grade machine.

In an earlier article [see issue of 27 December 1956, page 897] I envisaged three types of steam car enthusiast: *1* Those who want to build the entire machine, 2 Those keen on achieving speedier results by accepting a first-class i.c. chassis to which steam components might be introduced, *3* Those who are confining their activities to the design and production of steam engines and generators, plus the accessories essential to form a complete power unit.

Let me now define your objective as that of a completely new car, you to provide only the main power components and auxiliaries with the chassis and its body also where necessary. A measure of draughtsmanship will be necessary, and where you feel unable to tackle this side of the job try and interest a competent friend in your project.

I strongly advise the use of standard wheels and tyres, axles (front and rear), suspension, steering gear and brake components, as these will have been proved already in service and will function with complete reliability. These parts could be purchased from the maker of an i.c. model of approximately similar axle loads, with, possibly, the chassis also.

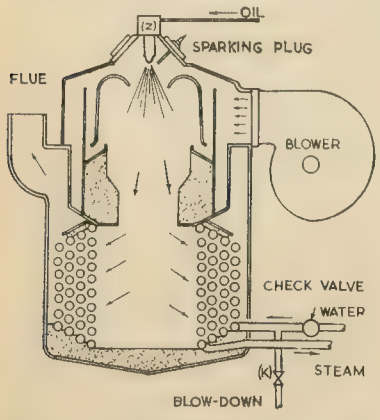


Fig. 3: *Diagrammatic section of the Vapor-Clarkson steam generator*

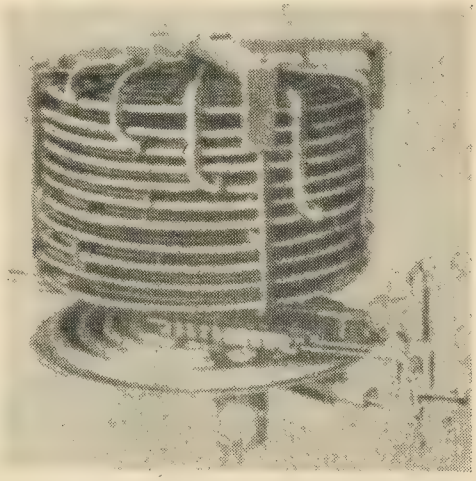


Fig. 4: *A* 1903 *White monotube steam generator*

STEAM GENERATOR

Three main types of steam producer are in use for motor-car service, these being illustrated in ME [3 January 1957, page 23]. The fire-tube unit, though slower in raising steam from cold than the others, can be relied upon, if correctly designed, to hold and maintain a good reserve of steam when climbing a long grade.

This is not the boiler suggested for your present purpose, however, as it can only be made foolproof and suitable for the average unskilled motorist's use with difficulty. The necessity for a glass water gauge is ample proof of this fact, but the experiences of many non-technical drivers in the earlier days of Stanley and Locomobile cars lend alternative confirmation to my statement.

Of the remaining alternatives, the water-tube and the flash type, my recommendation is definitely for the flash generator, similar to the Doble (Fig. 2). The water-tube unit has many fine features, though it cannot compare with the flash type, and here also the experience of seasoned drivers of steam cars backs this latter type as the ideal for the machine envisaged.

Here, however, lies a problem which readers must settle for themselves—who shall design and manufacture the steam producer? As this component is, perhaps, the most vital in the whole car assembly I would strongly advise its purchase from a maker with experience in the production of a unit for which he will guarantee steam pressure, temperature and capacity (pounds per hour) to meet the requirements of the engine selected and its demands under peak loadings.

The buyer, of course, would naturally require the maker to submit his product for inspection under test before delivery.

Before going on to discuss the accessories for the generator I would like to mention that an interesting design of unit for stationary service, the Vapor-Clarkson, is now available in sizes which vary in output from 650 lb. to 15,700 lb. per hour, and in two pressure ranges—up to 300 p.s.i. and 600 p.s.i.

A diagrammatic sectional illustration of this unit is shown in Fig. 3, and I understand that J. Stone and Co., of Deptford, London, SE13, are the sole makers in Great Britain.

A STEAM CAR DESIGN . . .

Another interesting example of flash generator is shown in Fig. 4. This shows a 1903 White monotube steam generator with its vaporising burner below the coils.

A word of advice is necessary at this stage for those who propose making their own generator. So far as its design is concerned, make quite sure you have a thoroughly good scheme developed on the drawing board, and go out of your way to get —and satisfy—all the expert criticisms you can before construction begins. Remember the superheat at which you propose to work, and contact only those makers who are experienced in the manufacture of the correct alloy steel tubing.

THE BURNER

If a complete generating set is being purchased, however, a burner of proved efficiency will be included, but if you propose making your own set from scratch experiments will have to be carried out on a "mock-up" or preliminary assembly basis.

Many engineers regard the Doble steam-raising plant as one of the finest attainable, and I believe that even this could possibly be improved by development work and tests, though these would demand the resources of a well-equipped engineering works.

An examination of the Doble generator (Fig. 2) shows, to the left, the motor for driving the small multi-bladed fan which provides the air requisite for consumption of the fuel. The latter is fed through a carburettor type burner, the air stream carrying the mixture through the venturi tube into the combustion chamber above the tube "pancakes"; en route the mixture passes an activated sparking plug, and is at once ignited.

The entry tube to the combustion chamber is set at a tangent to ensure a swirling action round the chamber for perfect combustion, the products passing through a 10 in. dia. opening in the lower dividing partition; the combustion chamber is heavily insulated to avoid loss of the heat generated.

An essential addition to the burner equipment takes the form of an electrically-controlled damper situated in the burner tube, its operation being by a solenoid which comes alive immediately the fan stops. Its inclusion and reliable functioning is necessary to prevent the fumes reversing their direction of flow and leaving the combustion chamber by the wrong outlet, with possible fouling of the atmosphere in the car.

A sectional view through a fuel spray valve is shown in Fig. 5.

BOILER ACCESSORIES

The boiler accessories vary according to the type of generator, and are principally concerned with the water feed supply, that of fuel to the burner, and the avoidance of excess steam pressure and temperature beyond those fixed at the outset.

In the flash type of boiler it is deemed desirable to maintain the water level at approximately mid-height in the coils to ensure an ample head of steam for all eventualities.

In the Doble this is effected by the provision of an automatic bypass valve whose movement is controlled by the expansion of a reliable design of thermostat.

Remembering the leading features in the design of the flash type of generator you will appreciate that with the water at too high a level in the coils, the space or volume which remains for the evaporating and superheating processes will be insufficient to give the temperature desired to the steam before entry to the cylinders. On the other hand, if the level is below that desired, and the car enters a long, stiff climb, the engine may require more steam than the pumps can cover for, and speed falls.

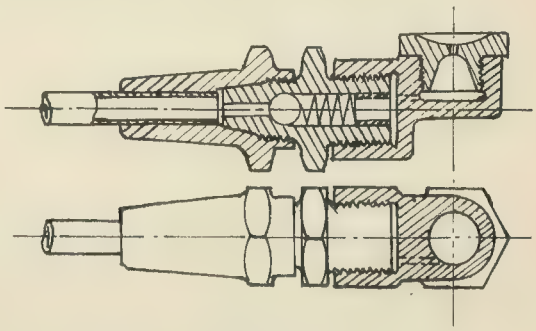


Fig. 5: Typical design of a fuel spray valve

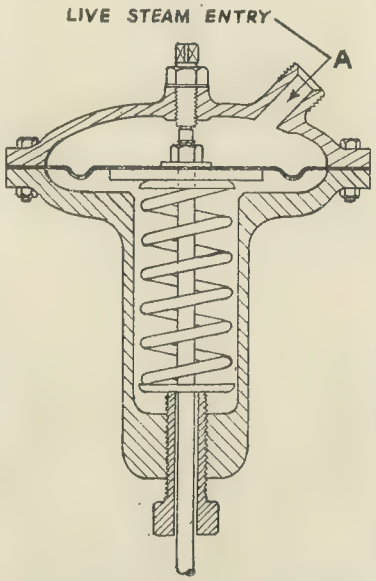


Fig. 6: Serpollet design of an automatic pressure-operated steam pump throttle valve

The boiler pressure may be controlled by a diaphragm valve (Fig. 6) subject at all times to the actual pressure in the generator; as this tends to rise beyond the limit chosen the deflection of the diaphragm can be arranged to break a contact in a relay, thus interrupting the current passing to the blower motor and to the fuel feed to the jet.

The current is interrupted only until the pressure has fallen sufficiently, when the relay restores the operation of the blower, and the burner again functions.

● *To be continued*

LONDON'S NEW COACH

THE new Green Line Routemaster double-deck coach, developed by the London Transport Executive with Leyland running units, recently entered service between Aldgate and Brentwood on route 721. This route passes through a heavily built-up area and during peak periods the service operates on a five-minute frequency.

The coach, the first of its kind, is powered by a 125 h.p. Leyland diesel engine, a type already fitted in more than 2,000 buses in service in London.

One of the most advanced features of the coach is the fully automatic gear change. Only two pedals—accelerator and brake pedals, are needed.

Beginner's Workshop

TWIN-CYLINDER ENGINE TYPES

By Geometer

AFTER single-cylinder and multi-cylinder in-line internal combustion engines, the twin-cylinder in its various forms is, perhaps, the most popular type, possessing the advantage of a smoother turning movement than a single-cylinder, yet with fewer parts and less complication than four and six cylinder engines.

The four common types of twin-cylinder engines are the vertical twin four-stroke *A*, the vertical twin two-stroke *B*, the flat-twin horizontally opposed four-stroke *C*, and the V-twin four-stroke *D*—this last somewhat less popular in recent years than formerly in the motor-cycle world. Any may, of course, be encountered full scale and all make attractive models.

In the vertical twin four-stroke *A*, the two crankpins are in line, the crankshaft has two bearings, and the centre "web" is generally circular as a flywheel, damping vibration to promote smooth running. On the four-stroke principle, two revolutions of the crankshaft are required for a complete cycle; consequently, in this engine the cylinders fire alternately, and there is a power stroke every revolution. Mechanical balance, however, is little, if any, better than that of a single-cylinder engine.

In the vertical twin two-stroke *B*, the cylinders are in line, but the crankpins are at 180 deg. A little reflection indicates the reason for this arrangement. If the crankshaft had the crankpins in line, as at *A* (but with separate crankchambers), then both cylinders would fire together—as the engine is a two-stroke, which cycle produces a firing stroke every revolution.

If, again, with the crankpins in line, one cylinder was situated so as to make a horizontally-opposed engine, then the balance would still be no better than that of a single cylinder. The actual layout thus achieves even firing (a power stroke every half revolution, the same as a four-cylinder four-stroke) with the best balance.

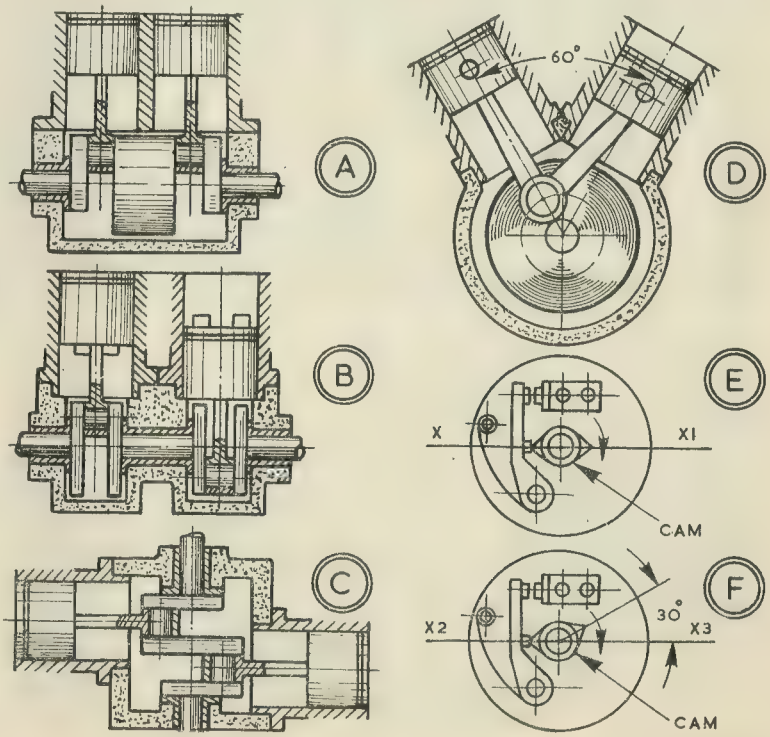
In the horizontally-opposed four-stroke, as at *C*, similar considerations apply. The cylinders still fire alternately, providing a firing stroke every revolution, and mechanical balance is very good—better, perhaps, than that of the twin two-stroke, as the opposing masses of pistons and connecting rods are more nearly in line, and there is minimum twist on the crankshaft. Using this crankshaft with the vertical twin cylinders at *A*, even firing could not be obtained—so what might be gained in balance could be lost in uneven turning movement.

The V-twin four-stroke engine, as at *D*, is a complete compromise, the justification for which is probably that it is compact and of a shape fitting well in a motor-cycle frame. The inclination of the cylinders, shown as 60 deg., may be more or less than that angle, since it is decided more from simple layout than from theories concerning even firing or balance. The two connecting rods are attached to the one crankpin—an arrangement slightly improving balance over that of a single cylinder, but not equalling that of a horizontally opposed twin.

Firing occurs as follows. Regarding the left cylinder as No 1 and at the firing position, the crankshaft makes one revolution to the original position, and must then pass through the cylinder angle (60 deg.) for the right cylinder, No 2 to fire. Following this, the crankshaft turns one revolution less 60 deg., which brings it back to the position at *D*, where No 1 fires. Firing is thus irregular according to the angle of the cylinders.

Ignition on a twin-cylinder can be provided by a single contact breaker and distributor, or by two contact breakers and coils, as is sometimes the case on twin two-stroke engines.

Using one coil, the contact breaker cam has two lifts, and the cam and distributor run at crankshaft speed on two-stroke engines, and at camshaft speed on four-stroke engines. For engines *A*, *B* and *C*, the two lifts are opposite, as at *E*, on line *X*-*X*1; but for the V-twin *D* the lifts, as at *F*, must be at an angle to line *X*2-*X*3, equal to half the cylinder angle. ▣



M P B REGATTAS

Wicksteed and Bromley

By Meridian

ALTHOUGH the power boat section of Wicksteed MY and PBC remains below strength, the club still manages to stage an open regatta each year and, as a result of a good attendance from both London and provincial clubs, this year's event again proved enjoyable.

W. Everitt (Victoria) starting MELODY *in the Timpson Trophy race*

Above: The line-up ! Competitors, with their boats, at the Bromley regatta

Below : P. Jessett (Blackheath) gets PANDORA *off to a good start. She is fitted with a small JAP industrial two-stroke engine*

The fine Timpson Trophy—it is one of the most handsome trophies in the power boat world—was won by Bill Everitt of the Victoria club with his 30 c.c. *Melody*. This boat is exceptionally reliable and can usually be relied upon to put up a run at around the 60 mark.

During the race for this trophy competitors had to contend with a very strong wind, and on one run *Melody* achieved a spectacular airborne progression for some distance —an almost unheard of occurrence for this boat !

W. Churcher (Coventry) refuelling ANNETTE 3

could score at all. The two leaders only gained two inners apiece and many re-runs were required to determine the winner. These two were both members of the Blackheath club —Messrs Jessett and Rayman, both of whom have boats with good steering qualities.

BROMLEY REGATTA

Facilities at the Whitehall recreation ground are not good owing principally to the small area of the pond, but despite this handicap Bromley MPBC have held several attractive events at this venue.

This year a programme of six events for free-running and radio-control craft was arranged, and apart from the last event being curtailed by rain, this ambitious programme was carried through very successfully.

Making their maiden appearance in regatta ; contestants attempt to pick up floating dolls with the aid of a wire hook fastened to the bows of the boat.

Winner of this contest was F. Fenn (Walthamstow), who managed to "rescue" no less than seven dolls.

RESULTS

WICKSTEED

Steering event

1 A. Rayman (Blackheath), *Yvette*: 6 points + 0 + 0 + 5
2 P. Jessett (Blackheath), *Pandora*: 6 points + 0 + 0 + 1

Nomination

1 E. Varey (Victoria), *Mickey*: error 1.2 sec.

Timpson Trophy, 500 yd Class A

1 W. Everitt (Victoria), *Melody*: 54.69 m.p.h.
2 J. Benson (Blackheath), *Orthon* 2: 52.4 m.p.h.

Newman-Lowke Trophy, 1,000 yd Class A

1 W. Everitt (Victoria), *Melody*: 53.96 m.p.h.
2 J. Benson (Blackheath), *Orthon* 2: 52.5 m.p.h.

Paten Cup, 500 yd Class B

1 J. Skingley (Victoria), *V7*: 54.4 m.p.h.
2 W. Churcher (Coventry), *Annette* 3: 52.5 m.p.h.

Class C Race, 500 yd

1 R. Phillips (St Albans), *Foz* 2: 63.56 m.p.h.

Orthon 2—her owner, J. Benson, was last year's holder—was reliable but slower than usual, and F. Waterton's new job *Tally Ho* was suffering from plug and fuel troubles.

In the Class B race for the Paten Cup it was refreshing to see a couple of excellent runs from a four-stroke engined craft. This was Bill Churcher's well-known hydroplane *Annette* 3 The recorded speed of 52.5 looked like winning until, at the last moment, J. Skingley managed to get a good run, which gained first place.

Straight-running events were very well supported but the wind played havoc with straight steering qualities. In the Steering event only a few boats competition work were members of Walthamstow Marine Club—a new club to MPBA events. This debut was a striking one since two of them were successful in contests.

In addition to the standard straight steering and nomination courses, there was a team relay event (Nomination) and, as usual, much entertainment resulted in the efforts of the various teams to catch and return the boats without losing valuable seconds. The race eventually went to a mixed team of Forest Gate and Victoria members—Messrs Phelps, Wood and Newton.

One of the radio events has now become a feature of the Bromley

C Restricted Race, 500 yd

1 K. Hyder (St Albans), *Slipper* 5: 63.13 m.p.h.
2 T. Everitt (Victoria), *Bill*: 62.36 m.p.h.

BROMLEY

Nomination

1 J. Slender (Welling), *Sarah Ann*: 0.3 error
2 G. Caird (Bromley), *BOAC51*: 0.4 error
3 L. Perkins (Victoria), *Lily*: 0.6 error

Steering

1 F. Waterton (St Albans), *Avocet*: 15 points
2 I. Wood (Forest Gate): 13 points
3 P. Jessett (Blackheath), *Pandora*: 11 points

Team relay nomination

1 Messrs Phelps, Wood and Newton: 0.07 error
2 Messrs Ayres, F. Waterton and R. Waterton 0.37 error

Radio event, picking up dolls

1 A. Norkett (Walthamstow), *WT6*: 7 dolls
2 L. Cassaney (S London), *Margaret*: 6 dolls

Radio relay event

1 Messrs Caird and Fenn
2 Messrs Cassanet and Archer

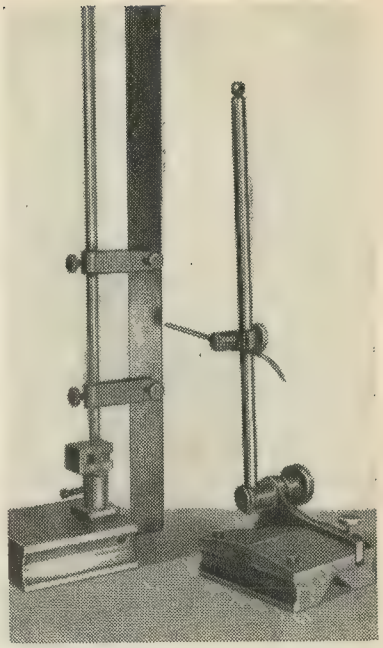
A rule holder for marking-off

By C. C. Rowland

During my apprenticeship in the tool room I made various small items of equipment for use in the shop, one of them being a rule holder for use on the marking-off table.

The detail parts are very simple and well within the capacity of the beginner with a small lathe. It is particularly useful for marking-out castings or forgings prior to machining or checking a first-off from the foundry.

When doing this the accuracy of a vernier height gauge is not necessary and one usually employs a surface gauge. The method of use, when, say, marking-off an unmachined casting employing a number of bosses and slots, also varying wall thicknesses, would be to select a main feature of the casting as a datum, set the surface gauge scriber point to this and then set a suitable division on the rule to the scriber.

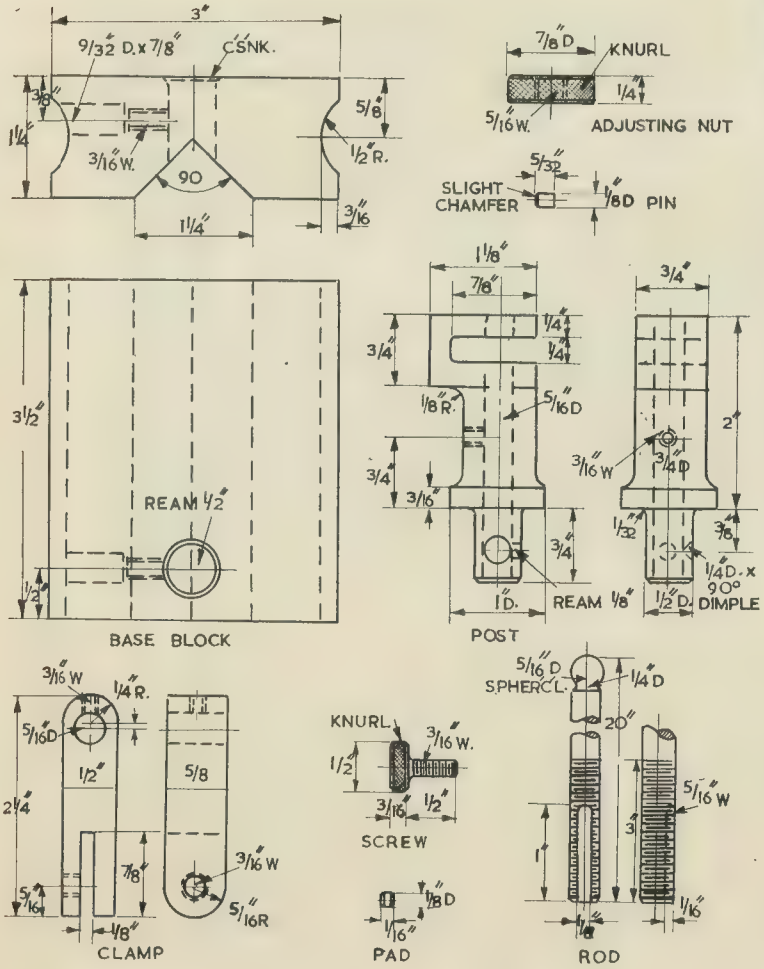


A rule in a rule holder being used in conjunction with a surface gauge

One should already know the relative positions of bosses and slots and from this the rule can be offered-up to the casting in question and adjusted accordingly up or down, thereby ascertaining whether the casting will machine to the dimensions required. The surface gauge can then be set to the appropriate rule divisions and the casting marked-off.

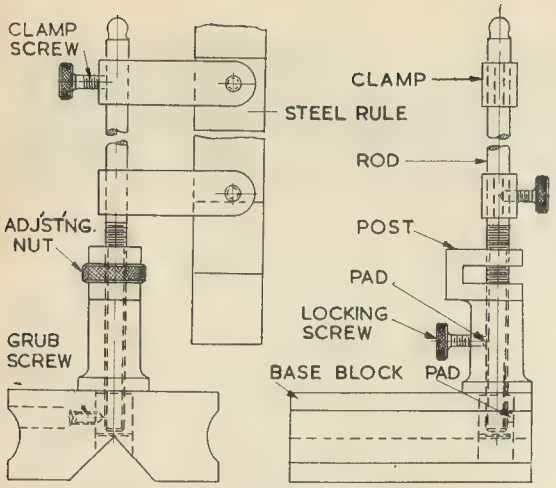
Any number of similar castings could be checked in this manner.

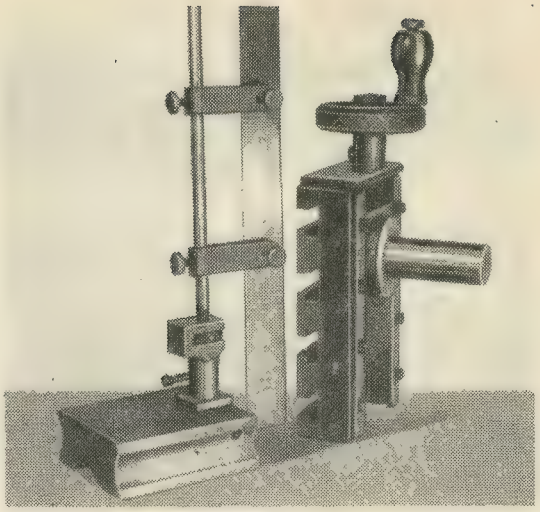
The measurements quoted proved to be a handy size, but a smaller or larger edition could be made according to requirements. ■



MATERIAL CUTTING LIST

Part	Size	No off	Material
Base block	1½" x 3¼" x 3¾" long	1	m.s.
Clamp	... ¾" x ⅞" x 5" long	2	m.s.
Adjusting nut	... ⅞" dia. x ½" long	1	b.m.s.
Post	... 1" x 1¼" x 3" long	1	b.m.s.
Rod	... 5/16" dia. x 20¼" long	1	b.m.s.
Locking screw	... ½" dia. x 1" long	1	b.m.s.
Clamp screw	... ⅛" dia. x 4" long	4	b.m.s.
Pin	... ⅛" dia. x ⅜" long	1	silver s.
Pad	... ⅛" dia. x 5/16" long	1	brass
Grub screw	... 5/16" Whit. x ⅜" long	1	Allen type





Above: The general arrangement

Right: Showing how the rule can be applied to marking-off a casting

Running the SMEE Track at this year's show

By W. A. Carter

THE first train was driven by the president, the Earl of Northesk, who drove the society's engine *1928*. In order to provide the visitors with the round of "preparation, running and disposal" the engines were scheduled for 1½ hr duty during the afternoon, and hourly duty during the evening. This fitted in with the staffing of the track.

During the ten days, no serious difficulties arose, the few "shed" headaches being of a minor character. The signal control was fitted with a counter and this recorded that 6,299 track lengths had been run during the show. When worked out to allow for the actual distance run by the engines, it amounted to 101 miles.

Scaling up from $1\frac{1}{16}$ scale to full size this is equivalent to more than 1,000 miles of shunting over approximately ¼ mile of track !

The signal treadles probably had the worst time of it. The distant treadles endured over 100,000 operations in appalling conditions of oil, water, sand and ashes, and lived to do it again !

The track always provides a gathering ground for those interested in small steam locomotives, and since they form a fair proportion of those who may be called model engineers there is a merry and lively enthusiasm.

One surprising fact is that so many people seem to see a passenger carrying track for the first time at an exhibition—every day the question was asked, "How does that engine pull a dozen children ? It doesn't make sense, it's impossible." Sometimes they could be convinced; often not.

One visitor from France stood watching the performance of the engines on and off, for an hour or so, then said: "This is most interesting; we have nothing like it. I will most certainly bring my two sons to see these engines working next year."

Finally, once again we had the pleasure of the company of Mr Vickerage and Mr Storey, both of whom have worked at the exhibition track for close on 40 years. May we see their happy faces for many years to come. ▣

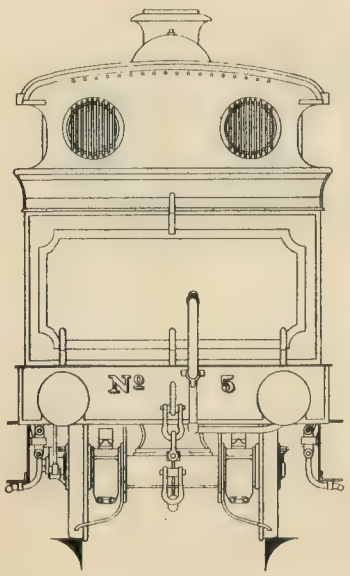
Engines run at the ME Exhibition 1957

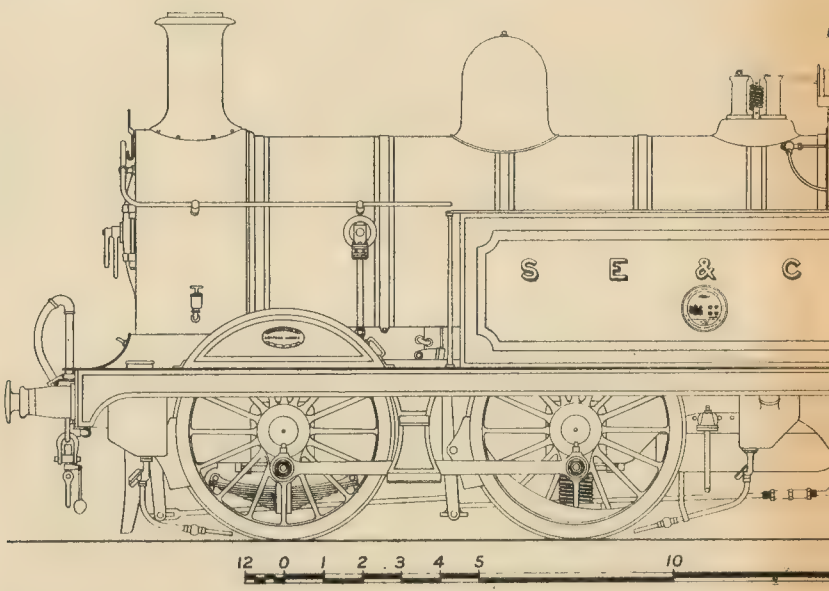
SMEE					
0-6-0	No 1928	...	... 5 in.	SMEE	12 hours
0-6-0	Lorna Doone		... 5 in.	Miss A. Carter	5 hours
0-6-0T	Hays Wharf and Dock		5 in.	Mr G. W. Vickerage	12½ hours
4-6-4T	LTSR	...	... 5 in.	Mr V. C. Storey	12 hours
4-4-2T	LTSR	...	... 5 in.	Mr V. C. Storey	6 hours
4-6-2	Conversion		... 4½ in.	SMEE	3½ hours
4-6-0	Cosmo Bonsor		... 4½ in.	SMEE	
2-6-6-4	Arthropod	...	... 3½ in.	Mr H. E. White	3 hours
4-6-2	Princess Royal		... 3½ in.	Mr A. L. Hutton	
4-6-2	Smeaton	...	... 3½ in.	Mr T. Rowland	1 hour
4-4-2	Maisie	...	... 3½ in.	Mr A. F. Brock	9½ hours
Chingford					
4-6-2	Hielan' Lassie		... 3½ in.	Mr Waller	2 hours
North London					
4-4-2	Atlantic	...	... 5 in.	Mr Wuidart	3 hours
0-4-0T	Mary ...	...	... 5 in.	Mr Marchant	1 hour
4-6-0	LSWR Paddlebox		... 3½ in.	Mr Mead	6 hours
4-4-2	Maisie	...	... 3½ in.	Mr Freeman	2½ hours
0-4-0T	Susie M	...	... 3½ in.	Mr Moon	3½ hours
South London					
4-6-2	Sir Rowland Cook		... 5 in.	Mr Wattingham	11 hours
Southend					
4-6-2	Pamela	...	... 3½ in.	Mr Mills	3 hours
Sutton					
4-4-0	Annie Oakley		... 5 in.	Mr F. Carter	3½ hours

LOCOMOTIVES I HAVE KNOWN

Number 45 by J. N. Maskelyne—Wainv

IN the course of the history of steam locomotive development in Britain, there have been many different types and classes of engines that never attracted any particular attention outside the railway for which they were built. Usually, they worked steadily and well at the tasks for which they were designed, but their fame, if any, was confined within the limits of their own territory.





Among such engines were the 0-4-4 tanks first brought out in 1904 by Mr Harry S. Wainwright as Class H for the South Eastern and Chatham Railway's suburban services. They were quite attractive engines in their original condition—stolid, sturdy and powerful—and they have always given satisfaction.

I remember when they were new, and in course of time I got to know the entire class; they were to be found all over the SECR system, though the majority were to be seen in the London area, whence, in addition to working on purely local suburban trains, they often ran through to such places as Redhill, Reigate, Guildford and Tonbridge on semi-fast outer suburban trains.

My acquaintance with this class began at Whitstable in 1905, and was much increased when we moved to a new country home at Edenbridge in 1909. At the latter place there are two railway stations situated about a mile apart; one, Edenbridge Town, was a former LBSCR station on the Tunbridge Wells direct line, the other belonged to the SECR on the Redhill-Tonbridge line.

Much of my time at weekends and holidays was fairly evenly divided between these two stations which, to me, were a kind of paradise !

The H-class tanks were very much in evidence in the Edenbridge area. Some were stationed at Tonbridge, others at Redhill, and they frequently worked stopping trains to and from London. One of them was No 5, the subject of my drawing, and I particularly remember her because of a curious experience I had when going home to our London house one Sunday evening.

I went from Edenbridge SECR station; the train arrived with engine No 5, and I got in, only to discover that I was in coach No 5 ! On arrival at Charing Cross, I went down to the Underground to take a train to West Kensington, and—yes !—I got into District car No 5, and then to cap all when I arrived at West Kensington I was just on the point of handing my ticket to the collector when I happened to catch sight of its number—it was 5005 !

There were sixty-six engines in this very useful class, all built at Ashford in the following batches: nine in 1904; seventeen in 1905; eleven in 1906; five in 1907; six in 1908; twelve in 1909; four in 1910 and two in 1915.

Why these last two should have been built after a lull of five years is something of a mystery; but a possible explanation is that they replaced two

older engines that had either worn themselves out or suffered war damage.

The leading particulars of these were given in great detail in the official specification, which was printed in full in *The Engineer* of 25 August 1905 to supplement the working drawings; some of the dimensions are very interesting, more especially those of the valves, valve-gear and valve events. The cylinders had a diameter of 18½ in. and a stroke of 26 in. and their centres were 2 ft 4½ in. apart; they were inclined at 1 in 9 to clear the leading axle.

The width of the steam ports was 1¼ in. and of the exhaust ports 2½ in., their common length being 16 in. The steamchest was between the cylinders, its centre line, in side elevation, coinciding with those of the two cylinders. The lap of the valves was 1 in. on the steam admission side, but there was no lap or clearance on the exhaust side. Due to the rather steep inclination of the cylinders, the leads differed, being ¼ in. for the front port but only $\frac{1}{16}$ in. for the back port.

Ordinary Stephenson link motion was provided and was arranged so that it gave a full-gear valve travel of 4 9/32 in. over the front port, but only 4$\frac{1}{16}$ in. over the back port. These figures are according to the official specification.

The eccentric sheaves were 1 ft 3¼ in. dia., and their throw was 3¼ in. The eccentric rods were 5 ft 2⅜ in. long, and they were attached to the top and bottom of the expansion links which were 1 ft 6 in. long between the eccentric-rod pins. The length of the connecting-rods was 5 ft 11 in.

Leading and driving wheels were 5 ft 6 in. and the bogie wheels were 3 ft 7 in. dia. The wheel base was 21 ft 10 in. divided into 7 ft 6 in. plus 9 ft 4 in. plus 5 ft. Leading and trailing overhangs were 5 ft 3 in. and 2 ft 1 in., respectively, and the total length over buffers was 32 ft 10⅜ in.

A thoroughly up-to-date and well-proportioned boiler was provided; it was pitched 7 ft 9¼ in. above rail level. The barrel was 10 ft 3½ in. long and was made in two rings, the larger (back) one of which was 4 ft 4 in. dia. outside, the thickness of the plates being ½ in.

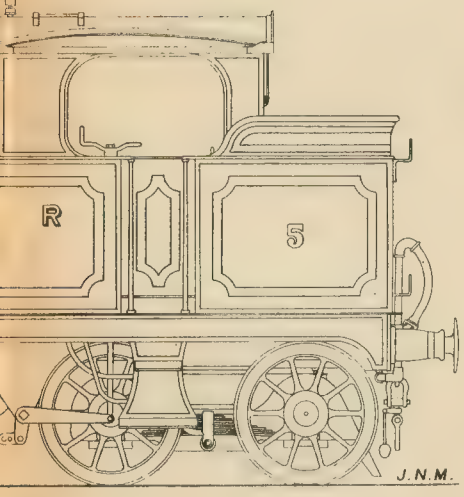
There were 205 brass tubes of 1¾ in. outside dia.; they were cambered 1⅝ in. as was usual in Wainwright boilers. The firebox was of copper, 4 ft 11$\frac{15}{16}$ in. long and 3 ft 4 in. wide at the bottom. The casing was of steel, 5 ft 8 in. long, 4 ft wide and 5 ft 11 in. deep, below the centre line. The total heating surface amounted to 1,104.65 sq. ft, made up of 1,002.45 sq. ft for the tubes and 102.2 sq. ft for the firebox. The working pressure was 160 p.s.i. and the grate area was 16.66 sq. ft.

The tank capacity was 1,200 gallons and the bunker would take 2½ tons of coal. Fully loaded, the engine weighed 53 tons 18 cwt, 33 tons 10 cwt resting on the four coupled wheels, evenly distributed, and 20 tons 8 cwt on the bogie. The tractive effort was 16,777 lb.

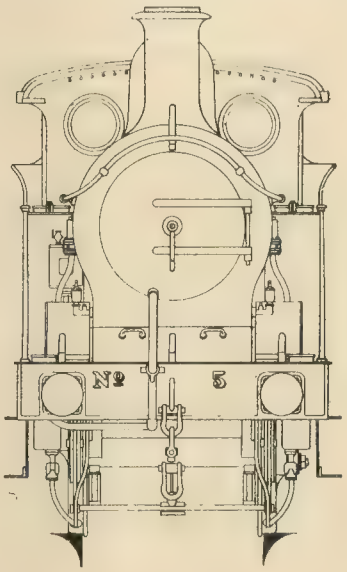
These engines were equipped with the automatic vacuum brake and steam sanding apparatus, and the smokeboxes were fitted up with Stone's patent spark arrester and fuel economiser. I must add that the height from rail level to the top of the chimney was 13 ft 2¾ in., and tip-up seats were provided for drivers and firemen.

It is rather curious that the 0-4-4 tank engine should have been so often criticised, if not condemned, by Board of Trade inspectors. True, there were several accidents involving 0-4-4 tank engines in different parts of the British Isles, and the BOT inspectors seldom failed to blame the 0-4-4 tank if the accidents should have occurred while the engines were travelling at speed.

Yet, in spite of the dictates of inspectors, the 0-4-4 tank was a popular and very reliable type found on most British railways, especially for suburban work. The Wainwright H-class engines were among the steadiest and most infallible suburban locomotives I have ever known, and I cannot recall a mishap that could be in any way blamed on to their design.



15



wright's H-class 0-4-4 Tanks, SECR

Still in service

At the moment of writing, more than forty of these stalwart engines are still in service—some of them far from their native haunts. They are largely used on push-pull auto-trains on branch lines or in provincial suburban areas; they can still be seen occasionally on ordinary stopping passenger trains, while there are several engaged on empty coaching-stock workings at large stations in different parts of the Southern Region.

They are officially classed as equal to the similarly-respected Drummond M-7 engines of the same wheel arrangement. In fact, in some districts they work turn-and-turn-about with them.

I have always had the impression that of the two classes the Wainwright engines were the sturdier and more robust; and I would not be surprised to learn that they had amassed a greater average mileage per engine. ▣

ZOE

The boiler accessories are the next items on the agenda, so LBSC describes how to make and erect the regulator and superheater

Continued from 17 October 1957, pages 548 to 550

It seems rather ironic that some of the most important components of a steam locomotive are completely hidden away when once made and erected, yet they have to be about right, or the efficiency of the engine suffers.

The regulator and superheater are cases in point; whereas trivialities such as the number of rivets in the buffer-beam, or the number of spokes in the driving wheels—both in full view—don't affect the working of the engine in the slightest, a faulty regulator or a badly-made superheater might well prove fatal! Therefore, I honestly advise beginners always to put their best work into *things that matter*. Nuff sed.

The regulator which I am specifying for *Zoe* is of the disc-in-a-tube type, as fitted to several of my own engines. One advantage of it is that it can be completely assembled and tested for steam-tightness before erection, and it can be easily removed at any time by disconnecting the superheater flange, unscrewing the steam flange and taking the screws out of the backhead fitting.

Incidentally, I have never had any occasion to take one out up to time of writing. They can be lubricated by dropping two or three spots of cylinder oil down the steam pipe through the screwhole in the dome.

The barrel is a piece of thin brass tube $\frac{5}{8}$ in. dia., which should be faced off at each end to an overall length of $2\frac{1}{4}$ in. At $\frac{13}{16}$ in. from one end, drill a 7/32 in. hole and tap it $\frac{1}{4}$ in. × 40, for the vertical steam pipe which extends into the dome.

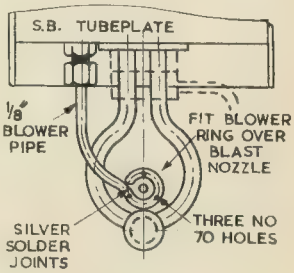
To make the throttle block, chuck a piece of $\frac{5}{8}$ in. round bronze or gunmetal, face, centre, drill No 48 for about $\frac{3}{16}$ in. depth and tap 3/32 in. or 7 BA. Centre deeply enough to leave a countersink. Turn down $\frac{1}{4}$ in. length to a very tight fit in the barrel and part off at $\frac{3}{8}$ in. from the end. Reverse in chuck and turn the outside to profile shown. Centre, drill to $\frac{1}{4}$ in. depth with 7/32 in. drill and tap $\frac{1}{4}$ in. × 40.

Be very careful about the next operation; at 3/32 in. from the edge, and 3/32 in. apart, make a couple of centrepops on the face. From these, drill 3/32 in. holes into the blind tapped hole as shown in the section. This job can be done by following the instructions for drilling the inclined passageways in the cylinders.

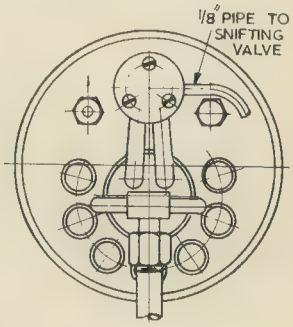
At $\frac{1}{8}$ in. to the left of a line drawn between the holes and through the middle of the little tapped hole, and a full $\frac{1}{16}$ in. from the edge, drill a No 55 hole and tap it $\frac{1}{16}$ in. or 10 BA for the stop pin. Chip away the metal between the two 3/32 in. holes on the face, to form one oval hole. True up the face by rubbing it on a piece of fine emerycloth, aloxite or other abrasive laid on something with a truly flat surface, such as the drilling-machine table or lathe bed (it won't hurt either), then screw a stub of 3/32 in. drawn bronze rod into the centre hole for the pivot, and a piece of $\frac{1}{16}$ in. ditto for the stop pin. Both should project about $\frac{1}{8}$ in.

I find that the best results are obtained when the valve and portface are made from different grades of metal. The late Harry Sturla gave me a number of sticks of cast bronze, and I use this material for throttle blocks and port blocks, the corresponding valves being made from drawn bronze or gunmetal. I am never troubled with valves sticking or leaking.

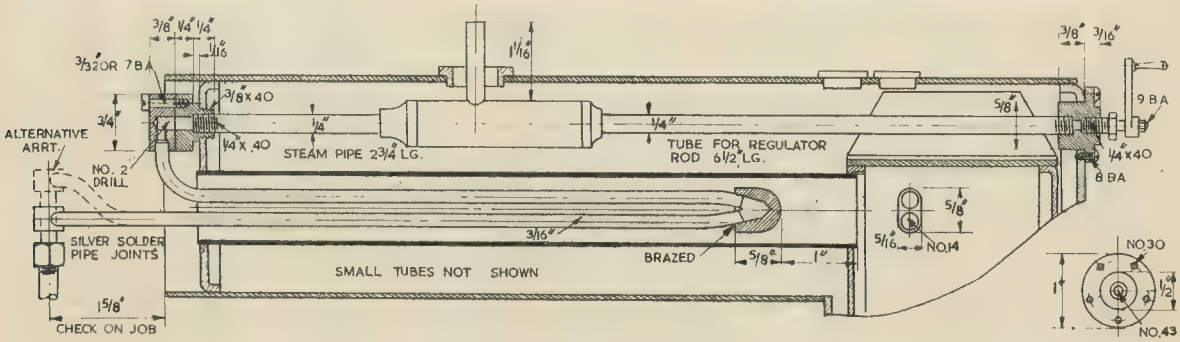
If you have a piece of suitable rod



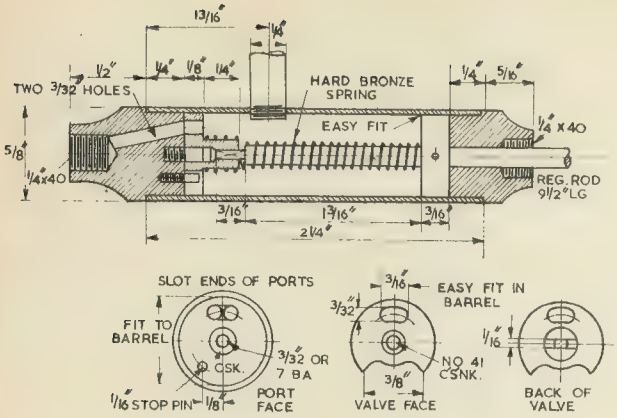
Above: Plan of superheater and the blower connections

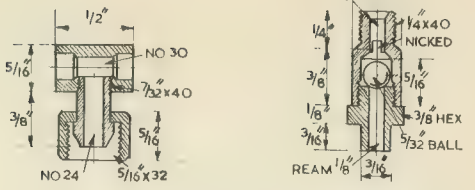


Above: Front view of the superheater



Arrangement of regulator and superheater





Above: Details of the superheater union and snifting-valve

Left: Details of the regulator

of different grade from that used for the throttle block, use it for the valve. Chuck, face, centre and drill No 41 to $\frac{1}{2}$ in. depth. Turn $\frac{1}{4}$ in. length to $\frac{3}{16}$ in. dia. and part off at a full $\frac{1}{8}$ in. from the shoulder. Reverse in chuck, skim the face true, countersink the centre hole slightly, and turn the edge to an easy fit in the barrel. Again, be careful.

Drill two 3/32 in. holes in a position exactly corresponding to those in the portface, run them into a slot with a small rat-tail file, and file out a segment on the opposite side to the holes, as shown in the drawing. Slot the boss, either by milling—I have already given instructions for milling slots in the lathe—or by careful filing with a watchmaker's flat file or a warding file. It doesn't matter which route you take, as long as you get there ! Finally true up the face as described above.

Test for trueness

You can soon tell if the faces are true by placing the valve on the portface, twisting it back and forth a few times, then setting it so that the holes in the portface are covered, the right side of the gap in the valve being up against the stop pin. Hold it there, and suck at the $\frac{1}{4}$ in. tapped hole. If no air comes through, the faces are O.K. If any does come through, take out the stop and pivot pins, and rub the faces on the emerycloth again, applying a spot of oil on them before putting them together again for another try. The second test usually proves all right.

The plug at the other end of the barrel is turned from $\frac{5}{8}$ in. round rod in the same way as the throttle block, but after reversing and turning the profile to given dimensions, centre, drill through No 30, open out with 7/32 in. drill to $\frac{1}{4}$ in. depth and tap $\frac{1}{4}$ in. $\times$ 40.

The regulator rod is a piece of $\frac{1}{8}$ in. rustless steel or drawn bronze rod $9\frac{1}{2}$ in. long. If using steel, make sure that it *is* rustless, or you'll get trouble. Turn $\frac{1}{8}$ in. length to 5/64 in. dia. and screw 9 BA. File the next $\frac{1}{8}$ in. to a 3/32 in. square. File $\frac{3}{16}$ in. of the other end to a tongue $\frac{1}{16}$ in. thick. Chuck a piece of $\frac{5}{8}$ in. rod (brass will do for this), face, centre, drill No 31 for $\frac{1}{4}$ in. depth, turn $\frac{1}{4}$ in. of the outside to an easy fit in the barrel, and part off $\frac{3}{16}$ in. from the end.

Drive this on to the regulator rod at the tongued end until it is $1\frac{3}{16}$ in. from the shoulder. The spring is wound up from hard bronze or brass wire, say 24-gauge, around a piece of $\frac{3}{16}$ in. rod held in the chuck. Bend one end of the wire at right angles, poke it between the chuck jaws, then pull the lathe belt by hand and guide the wire on to the rod with your fingers.

To assemble, press the throttle block into the barrel with the port lining up with the steam pipe hole in same. Put the end of the spring over the boss on the valve, and insert it into the barrel so that the gap in the valve will go over the stop pin. Push the long end of the regulator rod through the back end plug, and insert that into the other end of the barrel.

Endplay

While doing this, twiddle the rod with thumb and finger so that you can feel when the tongue enters the slot in the valve; then push the plug right home. The rod should then have about 1/32 in. endplay. If it has, the position of the disc on the rod is correct; if more or less, pull out the plug and rod and adjust the disc. When the endplay is correct, pin the disc to the rod with a bit of thin brass wire. I use brass domestic blanket pins, which are a nice drive fit in a No 56 drilled hole. Replace rod and plug, and another job is done.

Cut two pieces of $\frac{1}{4}$ in. copper tube to lengths of $2\frac{3}{4}$ in. and $6\frac{1}{2}$ in. respectively. Put a few $\frac{1}{4}$ in. $\times$ 40 threads on both ends of each, with the tube in the chuck and the die in the tailstock holder. Don't screw them by hand. Screw the shorter length into the throttle block and the longer one into the back plug. Anoint the threads with plumber's jointing.

Chuck a piece of 1 in. round rod (brass will do very well) or a casting may be available. Face the end, and turn $\frac{5}{8}$ in. length to $\frac{5}{8}$ in. dia. Centre, drill 7/32 in. to $\frac{3}{16}$ in. depth and tap $\frac{1}{4}$ in. $\times$ 40. Part off at $\frac{3}{16}$ in. from the shoulder. Reverse in chuck, turn $\frac{1}{16}$ in. length to $\frac{1}{2}$ in. dia. and skim the rest of the flange truly. Centre, drill through with No 30 drill, open out to $\frac{1}{4}$ in. depth with 7/32 in. drill and tap $\frac{1}{4}$ in. $\times$ 40. Set out and drill the screwholes in the flange with No 43 drill as shown.

Fixing flange

Screw this fitting on to the end of the long tube, with the regulator rod going through the hole in the middle. Push the regulator through the $\frac{5}{8}$ in. hole in the backhead until the shorter pipe just projects through the hole in the smokebox tubeplate, then adjust it until the hole in the barrel for the vertical steam pipe can be seen in the middle of the dome bush. Run the No 43 drill through the screwholes in the flange, making countersinks on the backedge. Drill these No 51, tap 8 BA and replace with a Hallite or similar jointing gasket between flange and backhead. Use 8 BA roundhead brass screws to fix the flange; they look neat.

Chuck a piece of $\frac{3}{4}$ in. round brass rod, face, centre and drill to $\frac{5}{8}$ in. depth with 7/32 in. drill. Tap $\frac{1}{4}$ in. $\times$ 40, turn $\frac{3}{16}$ in. of the outside to $\frac{3}{8}$ in. dia. and screw $\frac{3}{8}$ in. $\times$ 40. Turn the next $\frac{1}{16}$ in. to $\frac{1}{2}$ in. dia. and part off at a full $\frac{1}{2}$ in. from the end; reverse in chuck and skim the face truly. Chuck the rod again, centre and drill to $\frac{5}{16}$ in. depth with 7/32 in. or No 2

drill, face the end and part off a $\frac{3}{8}$ in. slice.

Put a smear of plumber's jointing on the threads of the first piece, and screw it on to the end of the steam pipe, until the outer threads also engage with the tapped hole in the smokebox tubeplate and the whole lot locks solid. In the second piece which forms the "wet" header of the superheater, drill two No 14 holes in the thickness, at the angle shown in the front view, so that they break into the central hole. The hole for the pipe from the snifting-valve is drilled at right angles to these with No 32 drill, and the screwholes are drilled No 41.

Screw a piece of $\frac{1}{4}$ in. copper tube $1\frac{1}{16}$ in. long into the hole in the regulator barrel, to take dry steam from the top of the dome. Make a gland for the backhead flange from $\frac{5}{16}$ in. hexagon rod by the process described for cylinder glands, and pack with graphited yarn. The handle can be filed up from 3/32 in. steel, and the boss brazed on.

Drill a 3/32 in. hole in it, and file it square to fit the square on the rod. The grip is turned from $\frac{1}{8}$ in. rod, leaving a pip on the end which is fitted into a No 53 hole drilled at the end of the handle and riveted over at the back. The handle is secured by a 9 BA nut. Fit it on the square so that when the regulator is shut, the handle inclines to the right.

SUPERHEATER

A superheater of the type illustrated has given complete satisfaction for over 15 years on my $2\frac{1}{2}$ in. gauge *Cock-o'-the-North*, and will be just as efficient on *Zoe*. The elements are made from $\frac{3}{16}$ in. × 22-gauge copper tube, two $8\frac{1}{2}$ in. and two $10\frac{1}{2}$ in. lengths being required. The block bends are filed up from two $\frac{5}{8}$ in. lengths of $\frac{5}{8}$ in. × $\frac{5}{16}$ in. copper rod or bar.

In the squared end drill two No 14 holes on the slant, so that they meet just inside the block (see section) then fit one longer and one shorter element into each, and braze the joints. Don't use silver solder at the firebox end. Just heat the joints to bright red after applying wet flux, and touch them with a bit of soft brass wire, or a $\frac{1}{16}$ in. Sifbronze rod, which will melt and form a fillet around each pipe. Heat the other ends to dull red before putting the job in the pickle.

Turn up the two shorter ends into easy bends of about $\frac{1}{2}$ in. radius, which is easily done by putting a piece of rod in the end to give the needful leverage. I always bend these small tubes with my fingers, which avoids kinking. Fit the ends into the two holes in the side of the flange, as shown in the front view. Chuck a piece of $\frac{1}{8}$ in. rod, face, centre and drill to $\frac{1}{4}$ in. depth with $\frac{3}{16}$ in. drill. Tap 7/32 in. × 40. At approximately the angle shown in the plan view (no need for "mike" measurements !) drill two No 30 holes breaking into the middle hole.

Open out the ends for about $\frac{1}{8}$ in. depth with No 14 drill. These holes should come within about $\frac{1}{16}$ in. from the end. Part off at a full $\frac{5}{16}$ in. from the end. It is easier to drill the holes before parting off the rod; you have something to hold while drilling. Bend the two ends of the longer elements into the shape of the pliers which form the rear anatomy of all earwigs, and fit them into the holes.

Finally fit a 4 in. length of $\frac{1}{8}$ in. copper tube into the No 32 hole in the side of the superheater flange, and silver solder all the joints at one heating. Use coarse-grade silver solder, and for flux use either Boron compo or jeweller's borax mixed to a paste with water.

Thorough wash

Let the assembly stand in the pickle for about 20 minutes, then give it a good wash, letting the water run through the elements to clear out loose scale, or anything else that might go down to the cylinders and score the bores and portfaces. The union can then be fitted. To make it, chuck a piece of $\frac{5}{16}$ in. bronze or gunmetal rod, face, centre, and drill No 24 for about $\frac{1}{2}$ in. depth. Turn $\frac{5}{16}$ in. length to 7/32 in. dia. and put about four 7/32 in. × 40 threads on the end.

Part off at $\frac{7}{16}$ in. from the end, reverse in chuck and turn the other end same as a union cone, either by setting the topslide over to a 30 deg. angle, or else using a chamfering tool with the edge set to the same angle. Reduce the diameter to a bare 9/32 in.

For the nut, chuck a piece of $\frac{7}{16}$ in. hexagon rod, face, centre, drill No 1 to $\frac{1}{2}$ in. depth, open out and bottom with 9/32 in. drill and D-bit to 7/32 in. depth, tap $\frac{5}{16}$ in. × 32, part off at $\frac{5}{16}$ in. from the end, reverse and chamfer. This union nut should have a flat-ended recess; hence the D-bit which is not used for ordinary union nuts. Slip the nut over the lining and screw that into the fitting carrying the ends of the elements.

An alternative arrangement would be as shown in the dotted lines. In that case, turn the lining to a length of 1 in. and silver solder it into the fitting (don't forget to put the nut on !) at the same heat as the rest of the assembly, instead of screwing it. The elements will need bending up as the dotted lines indicate, to allow the union to be connected to the steam pipe attached to the cylinders.

The superheater flange is then attached to the steam flange on the smokebox tubeplate by three 3/32 in. or 7 BA screws, with a 1/64 in. Hallite or similar jointing gasket between the faces. Fit a $\frac{1}{4}$ in. × 40 union nut and cone on the end of the $\frac{1}{8}$ in. pipe for connecting it to the snifting valve.

SNIFTING VALVE AND BLOWER RING

To make the snifting-valve, or vacuum-relief valve which is the "official" title that no engineman ever uses, chuck a piece of $\frac{5}{16}$ in. round rod in the three-jaw, face, centre deeply, and drill to $\frac{3}{4}$ in. depth with No 40 drill. Turn $\frac{1}{4}$ in. length to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{5}{8}$ in. from the end, reverse in chuck, open out to $\frac{5}{16}$ in. depth with 7/32 in. drill and tap $\frac{1}{4}$ in. × 40. Nick the bottom of the hole as shown.

Chuck a piece of $\frac{3}{8}$ in. hexagon rod, face the end and turn $\frac{3}{16}$ in. length to $\frac{3}{16}$ in. dia. Part off at $\frac{1}{4}$ in. from the shoulder. Reverse in chuck, turn $\frac{1}{8}$ in. length to $\frac{1}{4}$ in. dia. screw $\frac{1}{4}$ in. × 40, centre, drill through with No 34 drill, ream $\frac{1}{8}$ in. and take a skim off the end to true it up.

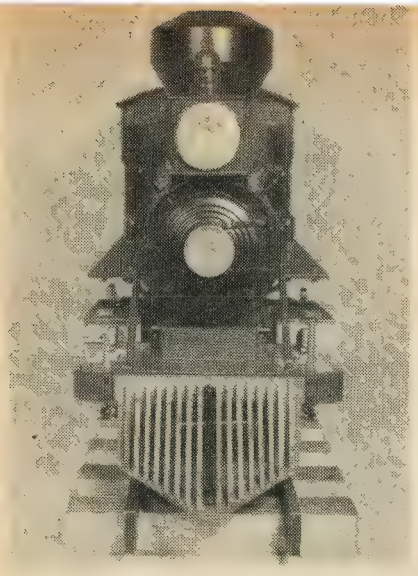
Sucking in air

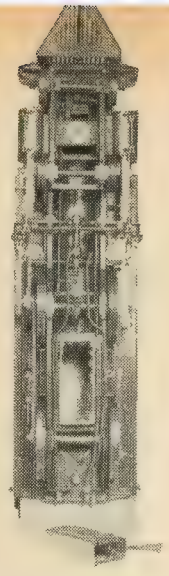
Seat a 5/32 in. rustless ball on the hole and assemble as shown. Couple up to the $\frac{1}{8}$ in. pipe on the superheater flange by the union already on. When the boiler is erected, the spigot is fitted into a $\frac{3}{16}$ in. hole drilled in the bottom of the smokebox just ahead of the vertical steam pipe, so that clean air is sucked in from below the smokebox.

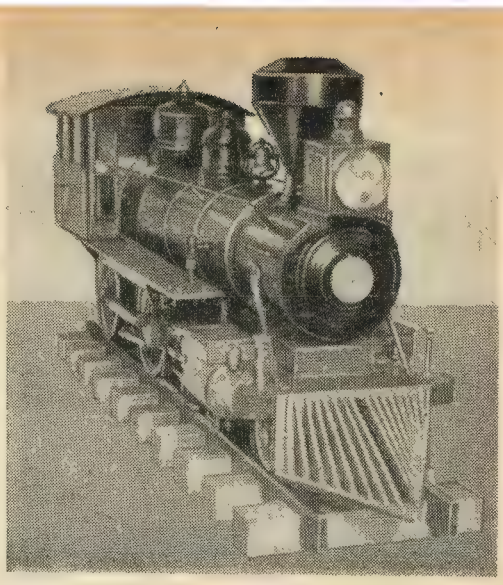
To make the blower ring, soften the end of a piece of $\frac{1}{8}$ in. copper tube and carefully bend it into a ring a bare $\frac{1}{2}$ in. dia. Silver solder the open end to the pipe, and be very sparing with the silver solder to avoid blocking up the pipe. Cut the pipe about 2 in. from the ring, fit a $\frac{1}{4}$ in. × 40 union nut and cone to it for connecting to the thoroughfare nipple on the hollow stay, and drill three No 70 holes in the ring, as indicated by the dots in the drawing. When the boiler is erected, this ring sits on the blast nozzle, so that the steam from the little holes goes up the chimney liner.

Next stage: backhead fittings, grate and ashpan.

● *To be continued*







R. T. EBERT, of Wooster, Ohio, built this

American Virginia

with a few personal modifications

My *Virginia* is now ready to go, with tender-building to follow in the coming months. Construction was started in late September 1956, with an estimated 1,000 hours of work on the project as seen here.

Working leaf springs were fitted, 18 assorted length leaves of commercial spring steel of 0.018 in. thickness. Leaves were locked in shackles with a through-pin, centre-hole punched and end-slotted with home-made punch and die sets.

Required set was obtained by a rolling machine described in a past issue of ME. Spring and equaliser assembly appear to be on the stiff side, but visual traction on air test-rail gives some promise of satisfactory working traction.

A visit to the Ford Museum in February of 1957 provided pictures and measurements from several old timers. Having made and operated *Juliet*, with loose eccentric gear, and *Maisie*, with Stephenson gear, a change to Walschaerts was desired, so the combination of diamond stack and Walschaerts are in conflict. However, the ancient character is apparent and, overall, very pleasing (at least to the maker !).

Lubricator, in standard location under smokebox, is actuated from pump eccentric rod, through a lost motion arrangement to reduce stroke and provide one notch-up per driver revolution.

Since the frame, action, reversing, smokebox and cab area were all completed and established before the boiler, it was possible to observe considerable care in fitting the boiler in the confined space allowed.

Cab front cut-out, of course, was left undersize for final fitting to the boiler. The cab roof is hinged at the front for easy running access to backhead fittings.

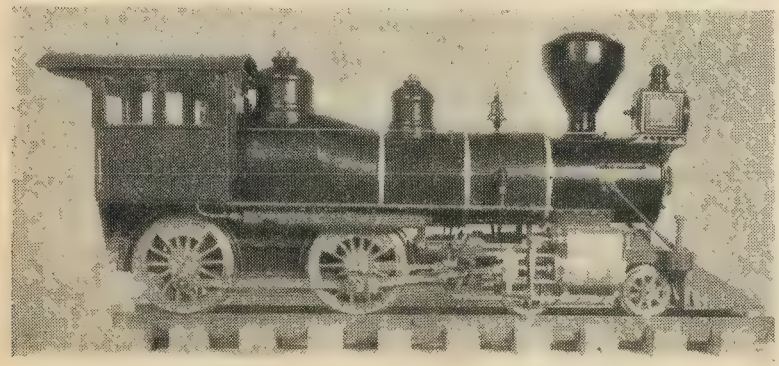
Safety-valve is the preferred pop-type, with dummy whistle omitted. Incidental details are: addition of fenders, a more prototype-like buffer, stainless steel grates, functional electric lantern, snifters in place of tallow cups and cab-operated cylinder blow-downs.

A boiler blow-down cock had to be fitted on side area of mud ring, between frame opening, where there is clearance inside of coupler rod. Cock cannot be fitted at rear of mud ring. Also, conventional boiler foundation clips are not practical on sides of rear area of boiler, as application conflicts with springs.

This was overcome by silver soldering a $\frac{1}{4}$ in. square bar at near-bottom of backhead and providing gravity bearing on the footplate well. In turn, the well can be buttressed with a 16-gauge steel, $\frac{1}{4}$ in. to $\frac{3}{8}$ in. wide, notched spanner over the frame just under the front edge of the footplate. No screws from boiler to support are necessary, as spanner support cannot shift and boiler is held down by cab, with automatic provision for expansion.

Wagon top dummy is tinner's copper, a friction fit and bolted by flange under the boiler. Colour scheme is emerald green on frame, red wheels, couplers and pilot, mahogany (steel) cab, domes and lantern, black smokebox and stack and dark blue boiler.

Any, or all, miniature locomotive projects have their problems at times in the long months before road-trial. *Virginia* was no exception, but results are very rewarding. ▣



The photographs on this page were taken by Milton Long

VIRGINIA PLANS

Plans for building *Virginia* are available from Percival Marshall Ltd, 19-20 Noel Street, London, W1. There are seven sheets, each costs 7s. 6d., including postage.

DUPLEX now turns his attention to a very handy workshop accessory . . .

A cross-drilling jig

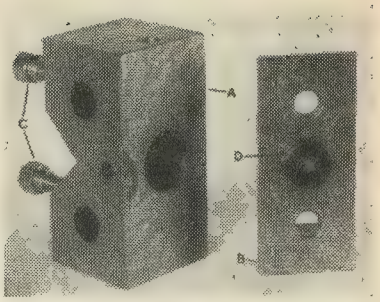


Fig. 4: The jig body and pressure plate

THE operation of cross-drilling machine spindles and other components has been referred to on so many occasions in these articles that readers will, I feel, be interested in a description of an appliance which has been used for this purpose in the workshop for a long time past.

A reliable test for checking the accuracy of a cross-drilling operation, carried out either with the aid of a jig or dependent on visual setting, is to turn a collar to fit closely on a shaft and then to drill radially through both parts. Where the resulting drill hole lies on the diameter line, a close-fitting parallel pin should pass through the two parts, both when in the zero position and after the collar has been turned on the shaft through an angle of 180 deg.

This may be a matter of some importance when, for the purpose of adjustment, a component has to be secured to a spindle in either of two positions; but with a well-made drilling jig this degree of accuracy should not be too difficult to attain.

Where the alternative method of visual setting is relied on, the shaft is first marked with a centre punch and then gripped in the machine vice with the punch mark uppermost. This setting can be made by placing the point of a scriber in the punch mark and aligning the blade by eye on the diameter line of the work.

Following this, the work is adjusted in the vice until the scriber is seen to stand at right angles to the surface of the vice jaws, and before the drill is entered, the punch mark must be enlarged with a centre drill to prevent the drill point from running off line.

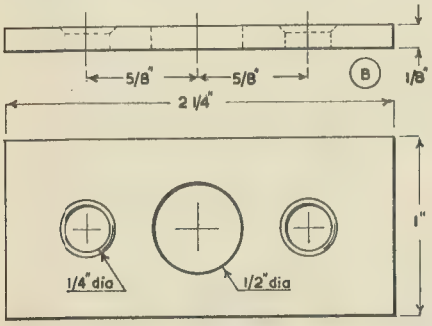
THE CONSTRUCTION

The drill guides fitted to the drilling jig consist of the collets made for the smaller of the die holders used in the workshop and, when these are pressed against the work by tightening the clamping nuts, the shaft is securely held and accurately aligned in the V-groove of the jig.

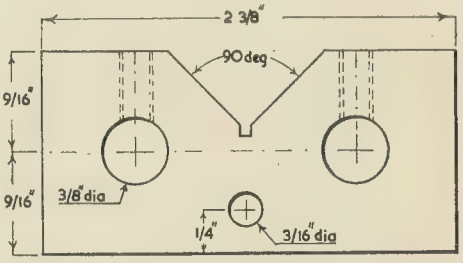
The body *A* of the jig can be made from either mild steel or cast iron and, provided it is large enough, the exact size of the material is unimportant. After the work has been filed or machined true and square, it is marked out to indicate the limits of the V-groove and the centres of the ⅜ in. dia. holes on either side of the centre line. The purpose of these drill holes is to accommodate the pegs of the work stop so that, when required, the stop itself can be fully closed and turned out of the way of the work.

A 3/32 in. dia. hole is drilled right through the material at the apex of the V and the surplus metal is afterwards removed with the hacksaw to enable the two oblique surfaces to be finished by hand filing or machine tooling.

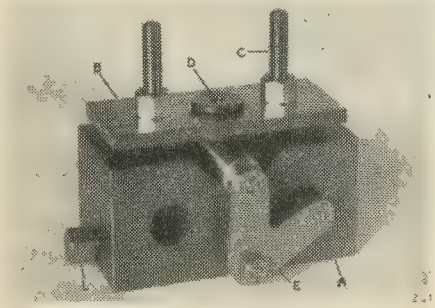
Although the machining operation can be readily carried out in the shaping machine by setting over the tool slide to 45 deg., it can also be



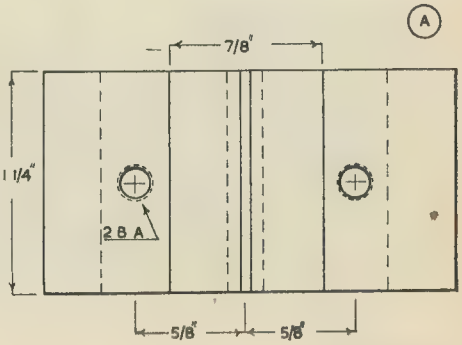
Left, Fig. 3: The pressure plate

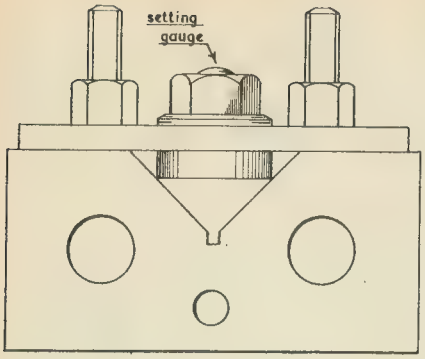


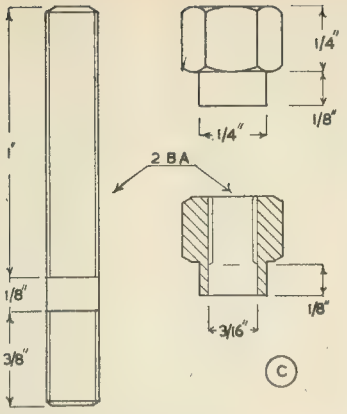
Right, Fig. 2: The jig body



Left, Fig. 1: The finished cross-drilling jig. A the jig body; B the pressure plate; C the clamping studs; D the guide collet; E the work stop; L the work stop clamping screw







done in the lathe by gripping the work at an angle of 45 deg. in a machine vice attached to the cross slide. The two limbs of the V are then machined in turn down to the scribed dimension lines by a fly-cutting operation with a boring bar gripped in the lathe chuck.

THE PRESSURE PLATE

Next, the two $\frac{3}{8}$ in. dia. holes and the $\frac{3}{16}$ in. dia. hole for the spindle of the work stop are drilled, but at this stage not those into which the two clamping studs *C* are screwed.

In addition, the stepped bore to receive the clamping screw *L* is drilled and tapped and the work is afterwards centred in the four-jaw chuck for drilling and boring the stepped recess in the under side of the base. To finish the body part its under surface is scraped flat with reference to a surface plate to ensure that, when in use, the jig lies evenly on the drilling machine table.

The pressure plate *B* is made from $\frac{1}{8}$ in. × 1 in. mild steel strip, which, after being cut to length, is drilled and finally bored to a close fit for the guide collets. The holes through which the clamping studs pass are drilled with a No 24 drill to serve as drilling guides for the stud holes in the body.

To ensure that the $\frac{1}{2}$ in. dia. hole in the pressure plate is accurately centred over the V-groove, the plate (Fig. 5) is fitted with a gauge piece and secured in position with a pair of toolmaker's clamps for drilling the two stud holes.

With this set-up simultaneous contact is made between the plate and the body and the gauge and the V-groove. Before the stud holes are tapped, they

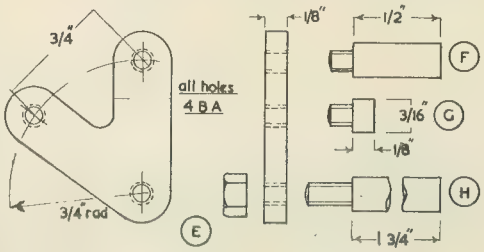
Top left, Fig. 5: The guide for centring the pressure plate on the V-groove

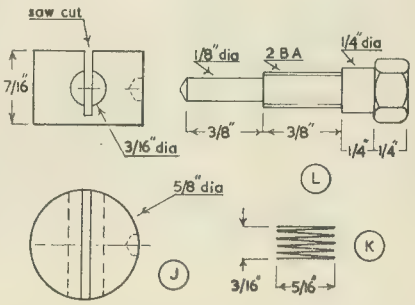
Above, Fig. 6: The clamping studs and nuts

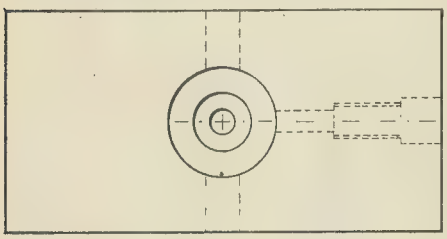
Right, Fig. 8: The work stop. E the quadrant; F and G the gauge stops; H the work stop spindle; J the spindle clamp collar; K the compression spring; L the clamping screw

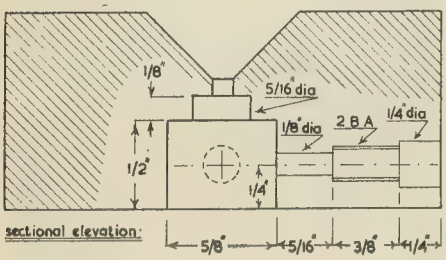
Below left, Fig. 10: The dimensions of the stepped bore for the clamping screw

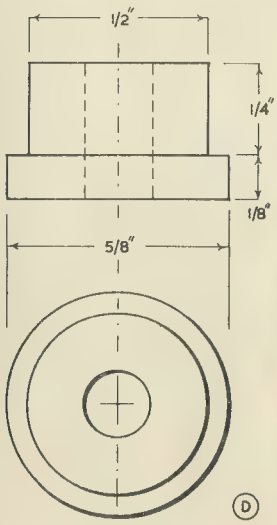
Below, Fig. 7: The guide collet











should be opened out for a short distance to $\frac{3}{16}$ in. dia., while the pressure plate is still clamped in place, to serve as a guide for the 2 BA tap.

Although tapping holes in this way by hand should ensure accuracy, advantage was taken of using the

●*Continued on page 623*

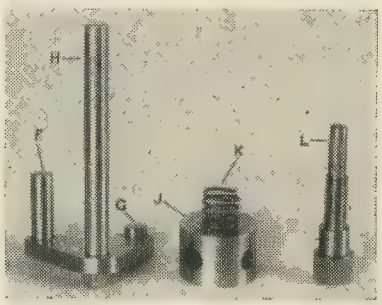


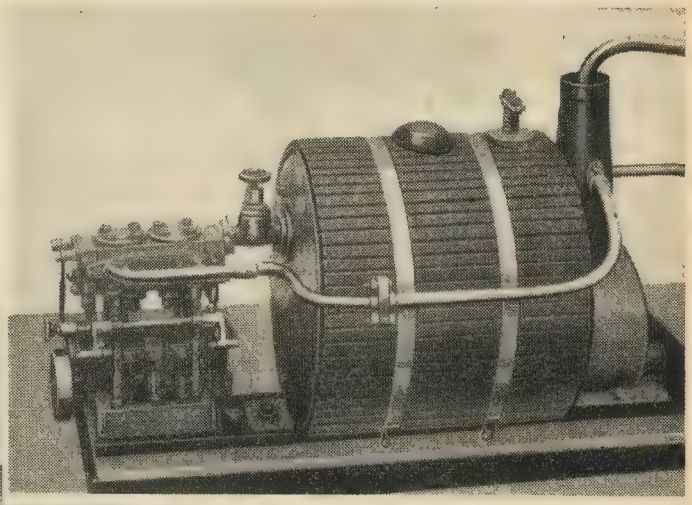
Fig. 9: The work stop components

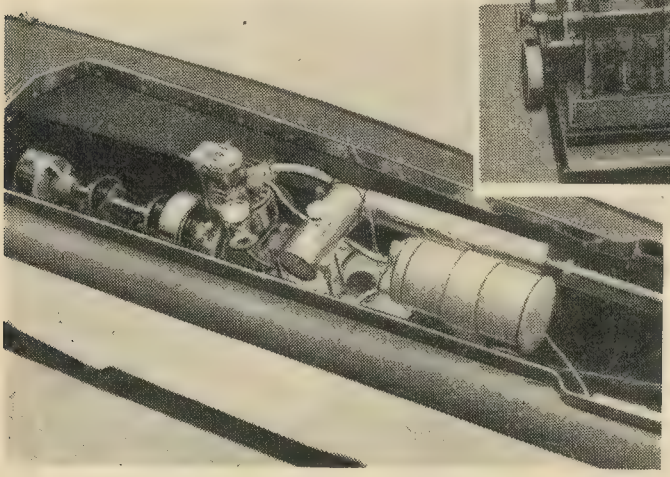
Power for model boats

First of a short series of articles by EDGAR T. WESTBURY in which he discusses various types of marine power plants, methods of installing them in model prototype craft, their suitability for certain classes of hull, and problems of transmission

IN their many and varied forms, ships and boats offer many attractions to model engineers. Their popularity may be rated as second only to locomotives, and would probably be even greater if more detailed and accurate information was available on their design and construction.

The problems of what types of craft to build, how to construct them and to propel them, constitute a large proportion of the numerous subjects dealt with by the ME queries service. Within recent months the interest aroused by the constructional articles on *St Ninian* by Edward Bowness has focused still further attention on these matters, and the time is ripe, I feel, for a general review of the subject, with illustrations and descriptions of typical examples of power plant installations.





Above: A twin-cylinder link-reversing steam engine and boiler, suitable for a model tug or launch

Left: The power plant of A. Falconer's torpedo recovery launch LULWORTH, *comprising a* 10 *c.c. C.I. Special o.h.v. engine, driving through a forward gearbox. The plant was built at sea*

It is not proposed to give technical details or constructional descriptions of the power plants themselves, as most types have been discussed at various times in MODEL ENGINEER—or will be in the future—but rather to assist the constructor in the choice of suitable engines and auxiliary equipment, and advise on their installation in boat hulls of many popular types.

The success of any model power boat is influenced not only by the efficiency of the power unit, but also by its appropriateness for the type of boat and conditions of running. While some boats may be suited equally well for accommodating two or three different types of engines, others are severely restricted in this respect by limitations of space, weight-carrying capacity, or other practical considerations.

While it is generally possible to build model boats to give a fairly accurate impression of the outline and appearance of the full-size prototype, including most, if not all, of the superstructure and deck fittings, it is rarely practicable to attain comparable fidelity in the interior working parts. This is particularly the case with reasonable-sized models of large vessels, such as liners or battleships. Something approaching scale realism might be attained in the engines of small craft, pinnaces or tugs for instance, though it is the exception rather than the rule to find any attempt to do so in working models.

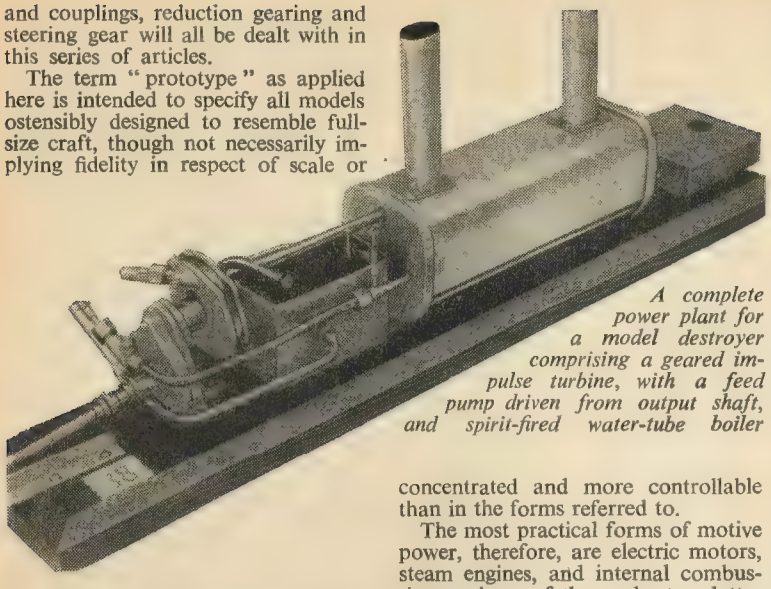
I have always considered, however, that the all too common practice of just putting "something that works" inside the hull, and leaving it at that, is very unsatisfactory, and that a great deal could be done to produce the authentic marine engineering atmosphere of the power plant, even though the engines cannot be built to scale.

By this I do not mean that engines should be camouflaged by enclosure in dummy casings or embellished with non-working auxiliaries and other fittings, but simply that their general character and mode of installation should be "all shipshape and Bristol fashion." To illustrate this point I have photographed a number of power plant installations in model boats which I consider to be well planned and neatly carried out. (Most of these pictures were taken either at the ME Exhibition or at the pond side.)

Apart from the actual installation of the propelling plant, consideration must also be given to the methods of transmitting power to the propeller —and the many queries which have been submitted on such items as stern bearings and glands, propeller shafts

and couplings, reduction gearing and steering gear will all be dealt with in this series of articles.

The term "prototype" as applied here is intended to specify all models ostensibly designed to resemble full-size craft, though not necessarily implying fidelity in respect of scale or details of appearance; but excluding purely experimental types such as racing hydroplanes, which are not copied from full-size practice.



A complete power plant for a model destroyer comprising a geared impulse turbine, with a feed pump driven from output shaft, and spirit-fired water-tube boiler

Wherever possible, I shall keep in mind the requirements of those readers who wish to run their boats not merely for personal amusement or relaxation but also for competition in club or inter-club regattas. This involves consideration of certain basic (though by no means irksome or hampering) rules, as laid down by the Model Power Boat Association, which controls these events in the United Kingdom.

FORMS OF MOTIVE POWER

Almost every known form of motive power has been applied with some degree of success to model power boat propulsion, but I propose to deal only with those that are likely to be well suited to the general conditions outlined. This rather tends to rule out some of the simpler power units which utilise *stored mechanical energy*, such as twisted rubber, clockwork, and even compressed air or gases, for though all these have been used in boats I have yet to see any success attained with them in competitive events.

In all cases the power they produce is very limited in duration and diminishes progressively throughout the run (the latter fault *might* be corrected by a suitable governing device) so that their performance is not very convincing, to say the least.

It might be argued that all kinds of engines employ stored energy in some form, such as fuel or electro-chemical force, but this is both more concentrated and more controllable than in the forms referred to.

The most practical forms of motive power, therefore, are electric motors, steam engines, and internal combustion engines; of these, the two latter are by far the most popular in boats which are designed for an active life in regatta competitions. They are all capable of furnishing a controllable, consistent and generally adequate amount of power through a rotating shaft for driving either paddle wheels or screw propellers, which have been proved to be the most convenient means of propelling model power boats.

The subject of jet propulsion cannot be entirely omitted from consideration in view of the attention focused on it in other spheres of modern power development. It has not, however, had any significant impact on model boat propulsion so far.

Small solid-fuel units have been employed for brief runs with very small models, and are quite spectacular in action, but attempts to run competitions for such craft have not been highly successful. Larger liquid-fuel jet motors have been produced and potentially, at least, are capable of developing continuous and efficient propulsive power, but they are so noisy and uncontrollable that it is considered unsafe to use them in competitions—either for racing or prototype craft.

The decision of the MPBA to ban jet engines some years ago was sharply criticised in some quarters, but it was influenced by the need to conform to insurance requirements and local regulations; also a conscientious regard for public safety. Incidentally, this ruling does not exclude the use of *hydraulic* jet propulsion, though the possibilities of this method have not, as yet, been explained so far as I am aware.

HOW MUCH POWER ?

Constructors of model boats are naturally concerned to ascertain how much power is required to propel a given hull at a specified speed, and many of the queries I have to deal with present this problem. To a great extent, however, "one guess is as good as another"—in other words, it must be regarded as a purely individual and experimental problem; in answering it, one can only be guided by past experience.

This is because the resistance of hulls, even of a given type and size, varies widely. Furthermore, it is often very difficult to estimate how much power can be expected from a given engine or how efficiently it can be utilised. This does not mean that we must abandon all attempts to find a solid basis for a power formula, but simply explains why it is impossible to give definite ready-made answers to questions on the subject.

It is, however, necessary in a practical discussion of any form of power plant to arrive at a clear definition of what the terms relating to power and performance mean. There are many misconceptions on this matter, and though it is dealt with at length in any textbook on principles of mechanics, I make no apologies for making a brief reference to it here.

Applied mechanical effort in any

A steam trawler installation by W. L. Jennings, with a Stuart Double-ten engine fitted with a centre-flue boiler

form or in any direction is defined as "force," and its unit of measurement is the "foot-pound," or the amount of force required to lift a weight of 1 lb. through a vertical distance of 1 ft against the opposing force of gravity. "Power" is a measurement of the rate at which a given force is applied, and can be expressed in terms of force per unit of time. As an example, the standard unit of "horsepower" is 33,000 ft-lb. per minute, and any arrangement of the factors which produces this product—such as 33 lb. lifted 10,000 ft, or 330 lb. lifted 1,000 ft in ten minutes—will produce one horsepower.

Force applied through a rotating shaft is known as "torque," and is measured in "pounds-feet"—note the distinction—each of which represents a force of one pound applied tangentially at a distance of 1 ft from the shaft centre. When force is applied in a straight line it is known as "thrust," and either torque or thrust may be "static" or "dynamic," depending on whether it is applied to stationary or moving objects.

"Energy" is a force-time equation, but capable of being totally expended over a variable pieriod, so as to produce a high power for a short period or a low power over a longer period.

Before dismissing the matter of definitions, it may be said that power conversion—alteration of the mode, rate or medium by which power is usefully applied—inevitably involves certain losses; the percentage of power available after losses have been deducted is known as "mechanical efficiency." The percentage of mechanical energy which can be obtained in practice by consuming a certain amount of fuel in a steam or i.c. engine compared with that contained in the fuel (calorific value) is known as "thermal efficiency."

Beyond these basic facts I do not propose to burden you with theory any more than is absolutely necessary. In fact, I hope to be able to steer clear of involved mathematics—not that I discount the value of mathematical calculation in engineering, but because it is so often difficult, even impossible, to find an exact basis for it in such an inexact science as model engineering.

Even the most superhuman electronic brain cannot produce the right answers if the figures fed into it are incorrect to begin with!

SCALE SPEED

It is generally desirable to run prototype model boats at a speed which bears scale comparison with that of the full-size craft, in order to give an impression of realism when under way. The definition of "scale speed" has been the subject of much controversy—and, at the risk of starting the old arguments all over again, I would suggest that many of the "formulas" which have been quoted for calculating this only confuse the issue still further.

Speed is a measure of distance in a given time, and as time cannot be scaled (by any means known to science!) it follows that scale speed can only be assessed on a linear basis. In other words, a model made to 1/12 the scale of a full-size ship which runs at 24 knots will have to run at two knots to attain scale speed. To put the matter still more simply, if a model covers its own length in exactly the same time as the prototype, it is running at scale speed.

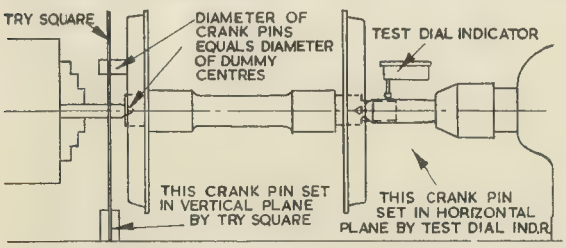
I am fully aware that other formulas, some of them very complicated, have been used for the assessment of hull efficiency in towing tests of experimental models and other research purposes; I am concerned here, however, not with the higher science of hull design, or any dogmatic assertions on the matter, but only with making sure that the term "scale speed" will be fully understood when referred to in these articles.

It may be mentioned that in competition work many model power boats are habitually run at well over scale speed, which may be all wrong in theory, but is practically a necessity to ensure navigability—in nautical parlance "steerage way"—in water and air currents far in excess of scale proportions.

To be continued

E. M. Thomas offers a hint on . . .

Quartering wheels


TRY SQUARE
DIAMETER OF CRANK PINS EQUALS DIAMETER OF DUMMY CENTRES
TEST DIAL INDICATOR
THIS CRANK PIN SET IN VERTICAL PLANE BY TRY SQUARE
THIS CRANK PIN SET IN HORIZONTAL PLANE BY TEST DIAL IND.R

HAVING recently had to quarter three pairs of 3½ in. gauge wheels, I thought that my method might be of interest to readers.

Six wheels had been finished, and their respective crankpins had been pressed home. The three axles were finished, each having one whee, pressed on fully. The problem! therefore, was to press on the three remaining wheels in such a position that their crankpins would be precisely at right angles to the other crankpins. The crankpins of the driving wheels were $\frac{3}{16}$ in. dia., and those of the leading and trailing wheels $\frac{3}{8}$ in. dia.

A start was made by making two steel bushes. Each bush was turned to an exact outside diameter of $\frac{3}{16}$ in. being bored and reamed $\frac{3}{8}$ in. at the same setting to ensure concentricity. Two lengths of $\frac{3}{8}$ in. silver steel were then set up truly in the lathe, and their ends turned to points having an included angle of 60 deg. One of these dummy centres was put in the tailstock chuck, the other being left in the split chuck in which it had been turned in the lathe.

The leading wheels were then taken, and with all surfaces clean and lightly oiled, the axle was pressed into the wheel boss by hand in its approximate position. It was left so that it still just could be turned by hand.

The axle was then placed between the two dummy centres in the lathe, the centres being gently tightened to retain the assembly in the required position. A try square was placed on the lathe bed, its blade in contact with the wheel's crankpin and the dummy centre nearest the headstock. This crankpin. therefore, is in the vertical plane, both crankpin and centre having the same diameter.

A test dial indicator was next set in the lathe's tool post and traversed by means of the cross slide over the crankpin and dummy centre nearest the tailstock. The difference in readings of the test dial indicator over this crankpin and centre indicate how far the crankpin is out of the horizontal plane, and in which direction.

It then becomes a matter of twisting the loose wheel until, with the try square in position, no deflection is shown on the test dial indicator over the dummy centre and crankpin. When this condition is attained, the wheels are truly quartered since crankpins and dummy centres are the same diameter.

For the pair of driving wheels with their $\frac{3}{16}$ in. dia. crankpins, the two $\frac{3}{16}$ in. bushes already prepared were slipped over the dummy centres, and the operation repeated. ▣

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

O.H.V. AND THE SEAL

SIR,—Referring to my design of an experimental o.h.v. conversion unit for the Seal [ME, August 29], I recently had a discussion with Mr Washington, of the Forest Gate Model Power Boat Club, who is the designer and builder of a number of successful four-cylinder engines in capacities of 15 c.c. and above.

He told me he had made experiments with air-cooled heads of the type described, and has experienced considerable trouble due to overheating, which caused pre-ignition and gasifying of the fuel/air mixture in the induction passages. In view of this, it is most likely that the head, as shown, will only be suitable for short runs unless water cooling can be introduced.

Those who have attempted the design of small multis of this type will know that the cored-in water spaces employed in full-size practice are difficult to reproduce in such diminutive sizes unless special methods are used, but it is a fairly simple matter to machine small water passages through the cylinder head which will, at any rate, limit the temperature of the thick section of metal through the centre of the head.

I have made further drawings of this arrangement which I will submit for publication together with two b.h.p. curves which have been obtained during tests of the side valve engine.

Shaftesbury, Dorset. R. H. R. CURWEN.

MICROMETER ACCURACY

SIR,—The description of J. E. Foster's micrometer [ME, July 11] interested me. The error of 0.002 in. at the end of the 2 in. range is not the important point, if this were all, when the error is known allowance can be made. It is extremely unlikely that a thread 5½ in. long, cut by hand with a commercial die, will have a constant pitch error. If accurate threads could be cut in this way how simple life would be for many people.

If Mr Foster uses his micrometer to measure a part in order to set calipers to size the mating part, he may get them to fit, because this depends on the clearance or interference and not on the actual dimension of one of the parts. Should he, instead, use it to produce a part to a stipulated dimension he could be badly disappointed.

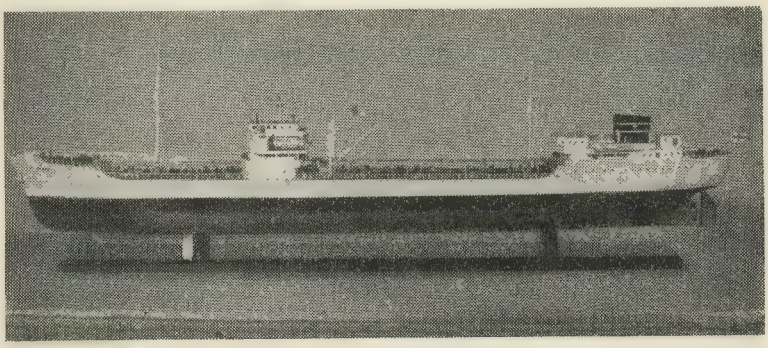
If Mr Foster lives in London and would bring his instrument to Brentford I would test it for him against standard slip gauges over increases of 0.100 in.

Brentford, Middx. D. W. E. KYLE.

COST UNDER £10

SIR,—While I was very disappointed to see *Ships and Ship Models* go, I'm glad to see that MODEL ENGINEER is devoting a fair amount of space to model ships.

As a contribution I'm enclosing a photograph of my model tanker, which I recently completed.



K. K. Nanni's model of the PENSA, *flagship of the Finnish Merchant Fleet*

She is the *Pensa*, flagship of the Finnish Merchant Fleet, built by Messrs Werf Jan Smit of Holland, who kindly furnished me with a set of drawings.

The model is built on the bread-and-butter system and with exception of the motor, three anchors and the cowl vents, which I bought, everything is made of scrap brass copper, plywood, etc.

The total cost was under £10, and that includes the 6 v. Taycol marine motor and batteries. She sails well and runs about 1¼ hr on a fully-charged battery.

She took 2½ years of spare time to build and has afforded me much pleasure and satisfaction.

Natal, South Africa. K. K. NANNI.

LONE HAND

SIR,—Vulcan's comment in "Evening Learning" [Smoke Rings, October 3] suggesting that some model engineers might enrol for evening classes to further their engineering knowledge caused quite a few shoulders to be shrugged.

Darlington, the home of *Locomotive No* 1 (and a Museum full of exquisite models) has almost completed the first part of a new technical college. Equipment includes centre lathes ranging from watchmaker's turns to massive 17 in. toolroom lathes; shapers, slotters, universal, plain and vertical milling machines; universal, plain, surface, die and cutter grinders; boring machines and capstan lathes. Drilling equipment at one end of the scale will handle a 3 in. drill; at the other, an octagonal hole can be made in a sheet of Pyrex glass.

If he wishes, the model engineer can burn his frames out of 3 in. plate on a profile cutter—there is a 2-ton crane to handle them! He can form his backhead on a 6-ton power press, and rivet, weld or braze it to a barrel which he has taper rolled. He can measure his work to 0.00001 in. and set his cylinders with an auto-collimator, and, when he has finished all, he can engrave his name and the date on the buffer beam.

Last year, over 1,400 students enrolled for formal studies—no mean feat in such a small town. Anxious to help the amateur, one night a week was set aside this year for model engineers to learn about and use this

POSTBAG . . .

great variety of plant. But evidently in Darlington they know it all—or, perhaps, like young Curly, tin cans and the kitchen table is all they need —for only one, *one*, model engineer turned up and *he* was a lone wolf !

TECHNICO.

OPTICAL TESTING

SIR,—I am making some eyepiece lenses for a Newtonian type telescope and I wondered if any reader could explain the method of testing glass for strain, using polarised light. Also, I would like to know if monochromatic light is better to use polarised than ordinary white light.

I realise that this is a question which is rather out of the ordinary run of model engineering.

Bradford, Yorks. D. K. PULLAN.

SHIPS' GRATINGS

SIR,—In *Ships and Ship Models* for July 1956 I came across an article by T. L. Wall in which he comments on small scale gratings for model ships. He states that in shops devoted to needlework it is possible to purchase a stiff cord pierced with 1/32 in. holes from which small scale gratings can be made.

I have tried in vain in the local shops for such cord and I am wondering if some reader can tell me where I may obtain this material.

Headington, Oxford. C. TURNER.

Two views of the steam ploughing set which Mr Jenner saw at work

FUTURE UNCERTAIN

SIR,—With reference to the letter by Ernest J. Woodman [Postbag, August 29] concerning a stationary steam engine situated between Cowfold and Horsham, Sussex, I visited this spot and, after a little difficulty, found the machine and took photographs and measurements.

The engine is a single-cylinder Marshall No 10257. It has two flywheels, the largest being about 5 ft 6 in. dia. The fire-tube boiler has 26 tubes, about 2½ in. bore.

I could not untie the waterproof sheet to examine the motion, but it appears to be in fair condition. The bore seems to be about 10 in., and the steam chest is rather shallow.

I was told by a local man that the owner (who used it with a large sawbench, which is still there) died recently, and its future is rather uncertain.

Brighton 7. G. GOLDRING.

PUPILS NEEDED

SIR,—I was most interested in J. S. Clifton's letter [Postbag, September 19]. Here in Doncaster the position seems to be reversed for we have tutors but insufficient members to keep the classes going. This sounds strange considering we are a railway town and I must conclude that the enthusiasts have not given consideration to the splendid facilities available in some of the institutes.

The Intake Education Centre, for example, functions in a fine new school with a nicely equipped workshop, and would welcome ME enthusiasts because we *can* provide the knowhow.

Intake, Doncaster. J. HIPPSLEY.

STEAM PLOUGHERS

SIR,—I enclose some photographs of a steam ploughing set taken just outside Harlow recently.

The engines carried a nameplate bearing the legend, John Patten, Hall Farm, Little Hadham, Herts. One of the drivers told me there was a similar set working a few miles away.

Harlow, Essex. F. H. JENNER.

OLD CYLINDER DESIGN

SIR,—In presenting the drawing for "Model Loco Cylinders" [ME, 3 October 1957], J.N.M. says of them: "The whole design has the merit of simplicity combined with just that amount of necessary machining and fitting to make a worth-while job from the constructor's point of view."

Surely, in this day and age, he cannot seriously intend would-be constructors to give the design serious thought, for the cramped steam-chests

G. Goldring secured this picture of a single-cylinder Marshall that stands in a Horsham, Sussex, field

with their necessarily small ports (drilled holes), small valves, unsupported valve spindles with meagre glands (or stuffing boxes) are all redolent of an era before LBSC showed us how to do the job properly.

After all the hard things that have been said about slotted screws in model locomotive work I am surprised that there is no mention of them in the text accompanying the drawing in question, though perhaps "slight modification of detail" may be said to take care of these "horrors."

I am intrigued by the joint between the valve spindle and the rocking shaft, and also the unusually long spigots on the cylinder covers, but if I were building a replica of some 1864 prototype I would certainly eschew this old drawing as a "design."

Louth, Lincs. JOHN R. BURDETT.

HEAVY EXPENSES

SIR,—I am more than pleased to read Vulcan's Smoke Ring on stamped addressed envelopes. This is a matter that has annoyed me many a time, being one of the technicians of the Readers' Queries service.

Many of our friends perhaps do not realise that expenses are incurred in this service. Each reply involves the use of three sheets of paper; this is bad enough but when it comes to the envelope and the stamp, it's not so good. Queries are dealt with without any charge to the inquirer. Were the information sought in other directions it could involve a fee of a guinea or so before an answer was considered.

An item that can also save time and money is the giving of sufficient detail where electrical inquiries are concerned. Quite often unnecessary correspondence and expense is involved on both sides through the vital details being left out of the query.

Where electric motors are concerned, it is necessary to have all the measurements of armatures and rotors. Diameters and lengths should be given, and the full details of the slots with measurements. Stators and field poles should be drawn to shape, or a rubbing sent. Calculations for re-winding or alteration cannot be carried out by guess work.

If these small matters are attended to a better service can be given all round. J.W.C.

HAT TRICK MEDALLIST

SIR,—Anyone who has seen any of Mr Reeve's clocks will not be surprised at the impressive list of awards [ME, October 3] he has gained during the past two decades.

Although horology is not in my own field of interest, I always admire his skill and excellent craftmanship, which are an incentive to any constructor.

I hope yet to see many more examples of his work, and bow to him.

Wembley Park, Middx. S. A. WALTER.

SMALL MAN'S YEAR

SIR,—Thank you, MODEL ENGINEER, for the resourceful article on the Russian modellers. Small hand tools on kitchen tables have spun the Iron Curtain into chicken wire.

This is a great year for little men; the international character of ME and the universal interest of its readers share a victory that is truly triumphant because there is no vanquished.

Romford. J. KITCHEN.

SHUNTING SENTINEL

SIR,—I have pleasure in enclosing a photograph of Super Sentinel No 5644, which I photographed at Teignmouth Quay in August.

As you will see this is of rather an unusual type, being similar to a Sentinel locomotive but having road wheels. It is used for shunting railway wagons on the quay.

Edinburgh 7. J. ROBERTSON.

RARE BARGAIN

SIR,—Resulting from the advertisement in MODEL ENGINEER I subscribed to the Scientific Book Club run by Foyles. The cost was ridiculously low, with the prevailing rate of exchange, and after receiving several most interesting books I would say this is one of the rarest bargains. Those who have not yet sampled this book club are missing something well worth while.

I have no connection in any way with Foyles.

Rothesay, NB, Canada. FRED MASSEY.

Cross-drilling jig . . .

workshop motorised tapping machine to tap the holes truly perpendicular to the surface of the work. To finish the plate the stud holes are enlarged to $\frac{1}{4}$ in. dia. to fit the skirts of the two clamping nuts. Unless standard collets are available, these components are turned from $\frac{5}{8}$ in. dia. m.-s. rod.

To ensure concentricity the bores of the larger collets can be finished to size with a small boring tool before parting off. Should there be any difficulty in drilling accurately from the tailstock, the bore should be first drilled in this way and the unfinished collet is afterwards mounted on a peg arbor which is machined in place when gripped in the chuck. By this means a light, traversing cut can be taken over the collet register to establish concentricity with the bore.

THE WORK STOP

The work stop is a useful addition to the drilling jig, especially for repetition work, to enable a hole to be cross-drilled at a measured distance from the end of a spindle.

As the edge of the pressure plate lies at a distance of exactly $\frac{1}{2}$ in. from the drilling centre, this surface can be used as a reference for setting the work. After a shaft has been clamped in position in the jig, the work stop is adjusted accordingly and then secured by means of the locking screw *L*.

The V-shaped head *E* of the stop is cut out from $\frac{1}{8}$ in. mild-steel plate, and afterwards three holes are drilled and tapped 4 BA at a radial and chord distance of $\frac{3}{4}$ in. for mounting the long spindle and the two short gauge stops, *F* and *G*.

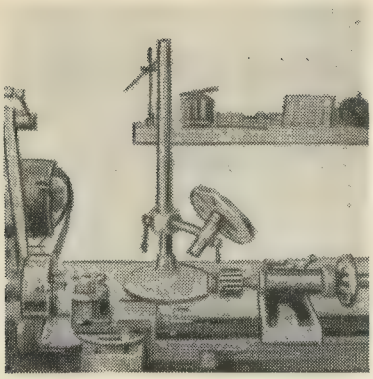
The collar *J*, which is housed in the recess bored in the under side of the body, is drilled radially for the passage of the stop spindle and is also slit nearly through with the hacksaw to enable the spindle to be gripped when the clamping screw is tightened. Frictional control of the work stop is obtained by inserting a short length of compression spring *K* in the $\frac{5}{16}$ in. dia. recess which lies above that machined to house the spindle collar.

The clamp screw *L* has a coned point to engage in the dimple drilled in the collar and its shank is machined to fit in the stepped bore already drilled and tapped in the body.

To ensure that the guide collet is correctly centred over the work mounted in the jig, the pressure plate when clamped in place must lie exactly parallel with the upper surface of the jig body, but this can be readily measured with a rule or by inserting a graduated taper gauge under the two ends of the plate.

If, when using the gauge, it is found that no guide collet of the right bore size is available, an oversize collet can be fitted to guide a larger drill for forming a drilling centre to locate a smaller drill that will bore a cross-drilled hole of the required diameter. ▣

This wonderful old Sentinel does duty as a shunter at Teignmouth Quay



From the SCRAPHEAP to the WORKSHOP

Odds and ends from a boilermaker's yard and a sandpit provided the materials for A. STEVENSON to build this ½ in. drill

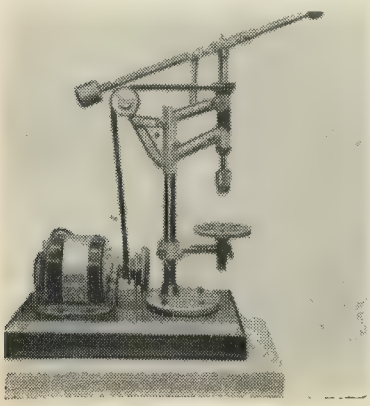
As I remarked in my article "Modification of a Clutch Unit" [ME, 27 December 1956]. I wanted more workshop equipment to make the operations for the varied jobs more simple and, therefore, more quickly executed.

It was with this in mind that I drew a plan of a drilling machine, styled somewhat on the lines of the ME drill, but to take drills up to ½ in. dia. This was necessary because I have two motor-cycles to maintain (a two-stroke for work and a combination for pleasure runs), and most fittings require at least a $\frac{5}{16}$ in. hole. So it had to be a ½ in. capacity drill.

Fabricated structure

Low cost was a must, so I decided that instead of castings, the main structure would have to be fabricated from whatever material came my way.

Starting, as most things do, from the bottom, the baseplate was found in a boilermaker's yard and was a piece of ½ in. mild-steel plate 10 in. dia. which had been cut out of a boiler plate by oxyacetylene. This was cleaned up on the faceplate and a 1¾ in. hole was bored offset to receive a piece of 2 in. dia. mild steel, which formed the spigot for the pillar. These were fitted a shrink-fit into the baseplate.



An old casting was found in a disused sand pit and this was utilised as the clamp locating the table to the pillar and a locking lever was made for fixing in position. A piece of ¾ in. dia. mild steel was shouldered down to ⅝ in. one end and butt-brazed to the other was a short piece of ¾ in. bore tube, which in turn had a half-round piece of mild steel brazed to it to take the table clamp lever.

Range of movements

As will be seen in the accompanying photographs, the drill table, which is a 5 in. faceplate casting, can swing about the pillar, rise and fall on the pillar, rise and fall and rotate on its own stem, and may be tilted to any angle, being locked by an Allen screw in the top face of the table locating clamp casting. Also, being 5 in. dia., the table is large enough to take the lathe topslide or machine vice.

The outstanding part of the headstock is that primarily it is a lady's cycle headlock, which has been cut off at about 5 in. down the tube and brazed on to a piece of 1¼ in. bore 8 s.w.g. tubing, which is a tight sliding fit on the pillar, the latter turned from an old half shaft.

All brazing was done by myself with the aid of Sifbronze rod, a blow-lamp and an improvised brazing hearth. The cycle head bearings were retained after the cups were machined to finer limits and rehardened. This allows a 1½ in. bearing for the bearing tube through which the chuck spindle passes, being driven by a ⅜ in. silver-steel stud located in the spindle and engaging in a slot 3 in. long in the bearing tube. As a screwed chuck has been fitted as a temporary measure, a ¼ in. hole is drilled in the spindle just above the chuck thread, to engage a tommy bar should the chuck become over tight.

Smart outfit

The jockey pulleys (bought as castings) and operating lever follow the pattern of drilling machines pictured in previous copies of the ME. The motor is of ¼ h.p. and runs at 1,240 r.p.m. All is mounted on a very fine piece of mahogany, which has been french polished, and this with the drill and motor finished in grey and maroon makes a very smart presentation.

Trials have been carried out and with the belt in the second groove of the motor pulley, a ⅛ in. hole can be drilled in a piece of ¼ in. m.s. plate in about 15 sec. Of course, several operations have to be carried out to drill the larger holes.

Although the drill is satisfactory, a Jacobs chuck and a depth gauge are being considered.

It was intended to show the drill at the ME Exhibition, but some work was still to be done. However, who knows, next year may see my drill or other piece of work up there among those gems of model engineering. ▣

Do not forget the query coupon on the last page of this issue

READERS' QUERIES

This free advice service is open to all readers. Queries must be on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope and query coupon with each query. Mark envelope "Query." Model Engineer, 19-20 Noel Street, London, W1.

The Eureka clock

I was very interested in the article on the Eureka clock. In fact, I would like to make one. Can you tell me what are the dimensions of the balance wheel and if there is any general formula linking the diameter and the mass of the balance weights? —C.D.B., Bognor Regis, Sussex.

▲ *An article dealing with the reconstruction of an old Eureka clock with a considerable amount of detailed information and working drawings was published in the issues of* MODEL ENGINEER *dated* 3 *and* 17 *February and* 3, 17 *and* 31 *March* 1949. *These issues are now out of print, but you may be able to obtain access to them at your local public or technical library or through a model engineering society. Alternatively, you might be able to obtain them by advertising in the small ads columns of this journal.*

It is not possible to refer you to any formula linking the diameter and mass of the balance weights, but the rate of the wheel will depend on its moment of mass in conjunction with the strength of the hair spring.

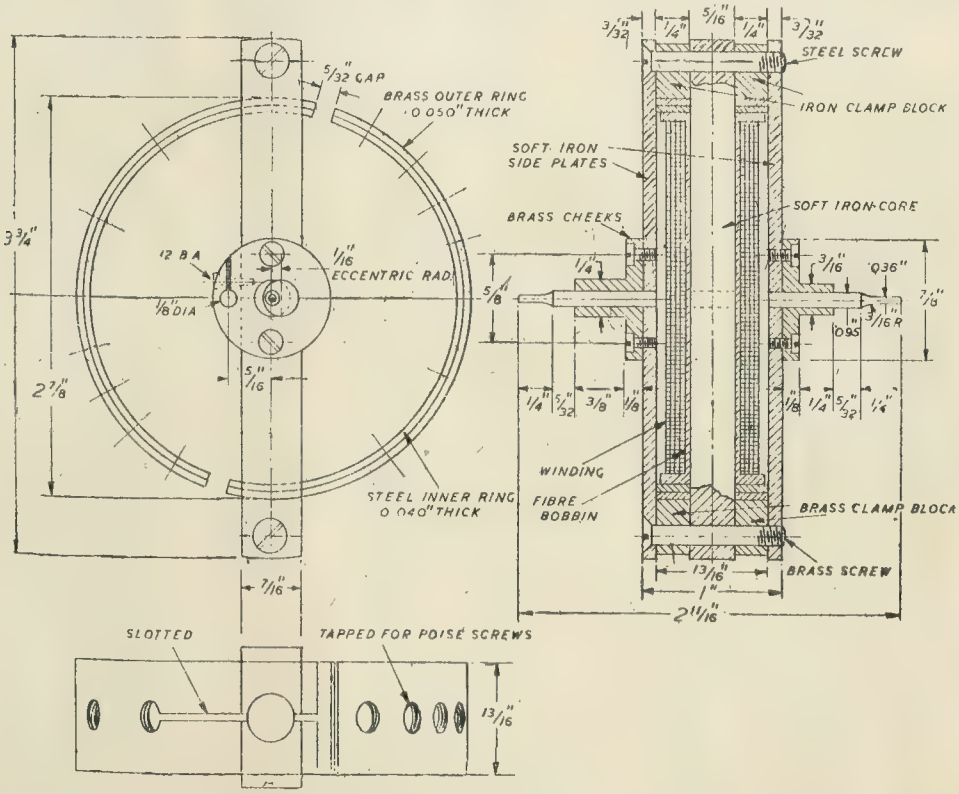
Heat for boiler brazing

I am having difficulty in brazing the boiler for my *Tich*. I have a Gilmore gas torch, which is able to heat the boiler so that Easyflo will run, but it is not hot enough to run the brazing strip. Therefore, I will have to buy some other form of heater, and would appreciate your advice.

I have no air supply, but I am thinking of buying an ex-WD air cylinder for about 30s. and using it at a low pressure. The air supply would come from a motor-car foot pump, with a member of my family as a "volunteer" operator.—J.T.P., London, NW2.

▲ *You are strongly recommended to use a gas-air torch, as it not only provides an adequate quantity of heat but also enables a very intense flame to be applied locally so that control of operation is facilitated.*

The matter of air supply will depend very largely on the size and type of blowpipe employed. High efficiency blowpipes, such as the Flamemaster, will use air effectively up to 20 *lb. pressure, though very useful work can be done at much lower pressures, down to about* 5 *lb. The air supply obtained from a motor-car foot pump would not be adequate for anything but a small blowpipe of the type used by jewellers. However, it is possible to obtain a low-pressure air supply from a fan blower, such as a vacuum cleaner, but much more satisfactory results can be obtained from a Vane or Rootes type blower or from foot bellows of a type designed for the purpose.*



Dimensioned drawing of the Eureka clock balance wheel. It comprises complete details of the construction, including the electro magnet and the eccentric which operates the gathering pallet

CLUB NEWS

EDITED BY THE CLUBMAN

WHAT'S new this season ? Every model rail car enthusiast at Portsmouth took a keen look at all the other models that appeared there when the MRCA held its first open event of the year.

Rain had been falling heavily and, with help from the tide, had flooded the pitch for the track. Despite this and the constant threat of more rain, all seemed well when practising began at about 11 o'clock. There was a downpour as the last race finished, but the weather cleared long enough for the prizes to be distributed without much discomfort.

What, then, did the watchful enthusiasts discover ? One new thing under the invisible sun was an Allen-Mercury 10 engine described to me as "a real record-breaker." G. Todd, of Bath, brought one into competition with the bigger FI cars and gained second place in the final.

The number of entries for the Formula 3 class proved the popularity of this size. About 98 per cent of the entries were powered with Mills 0.75 engines.

North London triumphed in the Formula 4 race, running under the title of Ecurie Point Cinq. These cars, the smallest to be run under **MRCA** regulations, are fantastic performers. All were fitted with the Victory Industries 1/18 scale bodies.

Here are the results :

Formula 1 (up to 1.5 c.c.)

Heat 1

1 A. Stocker	Alta	Portsmouth
2 P. Masterman	Connaught	Bournemouth

Heat 2

1 G. Todd	Cooper 1000	Bath
2 W. Chandler	Austin Healey	Portsmouth
3 W. Boddie	Austin Healey	Portsmouth

Final

1 A. Stocker	Alta	Portsmouth
2 G. Todd	Cooper 1000	Bath

Formula 2 (up to 1.00 c.c.)

Heat 1

1 G. Todd	Cooper 1000	Bath
2 A. E. Adams	Vanwall	Bournemouth
3 A. Dowell	Jaguar	North London

Heat 2

1 A. E. Adams	BRM	Bournemouth
2 W. Chandler	MG.TC	Portsmouth
3 E. Rhodes	Old Faithful	North London

Final

1 A. E. Adams	BRM	Bournemouth
2 G. Todd	Cooper 1000	Bath

Formula 3 (up to 0.75 c.c.)

Heat 1

1 W. Chandler	Lotus	Portsmouth
2 C. Orman	Vanwall	Bournemouth
3 F. R. Lee	Cooper 500	Bath

Heat 2

1 M. Pocock	Mercedes	Bath
2 A. Dowell	,,	North London
3 A. Stocker	,,	Portsmouth

Heat 3

1 G. Todd	Maserati	Bath
2 J. Wilson	Keife	Portsmouth
3 M. Pocock	Cooper 1100	Bath

Heat 4

1 P. Bailey	MG.TD	Portsmouth
2 G. Todd	Mercedes	Bath
3 B. G. Thomas	Cooper	Private

Heat 5

1 D. J. Lamb	Cooper 1100	Bath

Semi-final (1)

1 M. Pocock	Mercedes	Bath
2 G. Todd	Maserati	,,
3 W. Chandler	Lotus	Portsmouth

Semi-final (2)

1 P. Bailey	MG.TD	Portsmouth
2 D. J. Lamb	Cooper 1100	Bath

Final

1 P. Bailey	MG.TD	Portsmouth
2 M. Pocock	Mercedes	Bath

Formula 4 (up to 0.5 c.c.)

Heat 1

1 G. Barrett	MG.TF	North London
2 M. Gandolphi	TR2	,, ,,
3 G. Ward	,,	,, ,,

Heat 2

1 G. Ward	Lotus	,, ,,
2 A. Dowell	MGA	,, ,,
3 G. Barrett	MG.TF	,, ,,

Heat 3

1 G. Ward	TR2	,, ,,
2 G. Barrett	MG.TF	,, ,,

Heat 4

1 G. Barrett	MG.TF	,, ,,
2 A. Dowell	TR2	,, ,,

Final

1 G. Barrett	MG.TF	,, ,,
2 G. Ward	Lotus	,, ,,
3 G. Ward	TR2	,, ,,

Results of first round

Formula 1

1 A. Stocker	Portsmouth	13
2 G. Todd	Bath	10
3 W. Chandler	Portsmouth	2

Formula 2

1 A. E. Adams	Bournemouth	13
2 G. Todd	Bath	10
3 W. Chandler	Portsmouth	2

Formula 3

1 P. Bailey	Portsmouth	13
2 M. Pocock	Bath	10
3 W. Chandler	Portsmouth	4

Formula 4

1 G. Barrett	North London	13
2 G. Ward	,, ,,	10
3 M. Gandolphi	,, ,,	2

Maximum possible score: 14.

SHREWSBURY'S BIENNIAL

Other clubs in the area—from Wirral, Llandudno, Machynlleth and Newtown—are giving their support to the biennial exhibition of **Shrewsbury and District SMEE** to be held at its headquarters, the technical college at Shrewsbury, on November 8 and 9. Members hope that the **Newtown** society will have its model race car track operating.

For reasons of space the passenger-hauling locomotives can run only on the Saturday afternoon. Readers who intend to visit the show—and I hope that many of them will—should note that it opens in the evening of November 8, at seven o'clock, and resumes on the following day at 2.30.

The secretary of Shrewsbury and District SMEE is W. T. Howard.

EMPHASIS ON MODERN

Robert G. Davis (Lindum, 309, Arundel Street, Portsmouth, Hants) tells me that the **British Light Steam Power Society,** of which he is secretary, will wait until next year for a first-class show of steam cars. What he wants is an assembly of modern steam cars—five or six of them.

"The veteran steam cars," he says, "may be interesting, but a lot has been said about the performance of the modern steam car, and I feel that the opportunity should be given to those who are interested to see it in reality."

I doubt if he could find a steam car more modern than the home-built runabout by H. Claydon described in MODEL ENGINEER of October 3.

ME DIARY

November 1 Malden SME firework night.
Rochdale SMEE "Springs," A. Bonsor, Lea Hall, 7.30 p.m.
North London SME general meeting and jumble sale, ER Gas Offices, New Barnet, Herts, 8 p.m.

November 2 Bristol SMEE "What is Your Story ?" Folk House, College Green, 7.30 p.m.

November 3 MRCA Bournemouth, National Championship, open, Bournemouth MCC, 29 Ashley Road, Boscombe, Hants.

November 7 Eltham and District LS, *Petrolea* by G. Sheed, Beehive, 8 p.m.

November 8 Shrewsbury and District SMEE biennial exhibition, Technical College, Shrewsbury, 7 p.m., November 9, 2.30 p.m.
Malden SME, Bits and Pieces.
Thames Shiplovers, Building *Cutty Sark* model, H. G. Harrison, Oddi's Restaurant, Coptic Street, London, WC 2, 7 p.m.

November 9 Acton MES first exhibition, Baptist Church Hall, Church Road, Acton, London, W3, 11 a.m.-8 p.m.
Glasgow SME coloured slides, R. Kerr (Kirkintillock SMC).

November 10 IRCMS at Kingsley Hotel, London.

November 13 Birmingham SME auction sale, Crown Hotel.
Bristol SMEE, Ball Bearings, Folk House, 7.30 p.m.

Model Engineer

Classified Advertisements together with remittance should be sent to Model Engineer, 19/20, Noel Street, London, W.1, by latest Thursday morning prior to date of publication. Advertisements will be accepted from recognised sources by telephone. GERRARD 8811. Ex. 4.

CLASSIFIED ADVERTISEMENTS

★ Private: 3d. per word. Trade: 6d. per word. Minimum 12 words. Use of box 1s. 0d. extra.
★ Rates for displayed advertising in this section. Trade 35s., Staff 45s. per single column inch. (Column width 1⅞ in.)

The Advertisement Manager reserves the right to refuse or suspend advertisements without giving any reason. Every care is taken to avoid mistakes, but the publishers cannot be held liable in any way for printing errors or omissions. Receipt of "copy" for publication implies acceptance of these conditions by the advertiser. Whilst every care is taken to exclude advertisements from doubtful sources, no responsibility can be accepted by the publishers for the bona fides of advertisers.

WORKSHOP EQUIPMENT

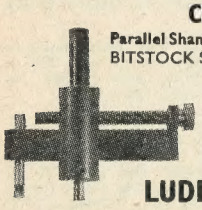
Buck & Ryan for Lathes and Workshop Accessories, drilling machines, grinders, electric tools, surface plates, etc.—310-312, Euston Road, London, N.W.1. Phone : Euston 4661.

Milling, Grinding, saw table attachments, turrets or castings. Drill grinding jigs, collets, B.A. screws. List 6d.—G. P. Potts, Yew Grove, Troutbeck, Windermere.

B.O.G. Alda Welding Set model B, complete. Also cutting outfit. Offers—Box No. 8662, Model Engineer Offices.

Bridges Home Workshop, many extras, as new, cost £34, accept £26 o.n.o.—Heslin, 143, Ramillies Road, Sidcup, Kent.

ADJUSTABLE PARALEX HOLE CUTTER



Parallel Shank ⅜", capacity 4" 26/-
BITSTOCK Shank, capacity 4" 27/6
Carr. paid, incl. packing.
Also Taper Shank Models
Send for illustrated price list

LUDFRY LTD
5 Hanway Place, London, W.1
Telephone: MUSeum 7472

£65, M.L.7 on cabinet stand, 4-jaw, 3-jaw, D. chucks, collets, universal slide, union bench drill, tools, etc., less motor.—2, Isabella Road, Homerton, London, E.9.

Myford ML7 Lathe, suds pump, solid bench, milling attachments, chucks, many other extras, £75 o.n.o.—Kandelglow, Forest Road, Binfield, Berks. Bracknell 1365 evenings.

New Tools. Send s.a.e. for new free list of drills, taps, dies, milling cutters, blades, reamers, internal grinding wheels, at bargain prices.—A. King, 152, Halfway Street, Sidcup, Kent.

EASIFIND ENGINEERS' REF. TABLES
- DEC. & METRIC EQUIVALENTS
- THREAD TAP & CLEARANCE DRILLS
- WHEELS FOR SCREWCUTTING
- TEMPERING COLOUR GUIDE
- STANDARD WIRE GAUGES
- WOOD SCREW DATA
- TWIST DRILL SIZES

1/9d. Post Paid
From **S. W. SIMMONS**
37, Derwentwater Road, London, W.3

Mail Order. New bargains, 1s. extra post under £1. Dies ⅛" 40 t.p.i., 5/32", 3/16", 7/32", ¼", 3s. 4d. each. Taps 40 t.p.i., 5/32", 3/16", 7/32", ¼", 2s. each. Hand bench drilling machine, ½" chuck 2-speeds, £5 10s. Burnerd independent chucks 4", 72s., 4½", 75s., 6", £6 4s. 6d. Self centring 4", £9 0s. 3d. Machine vices, 18s. 6d. Precision drill chucks ¼" No. 1 M.T., 43s. No. 2, 44s. Wood chisels set ¼", ⅜", ½", ⅝", 1", 16s. Expanding wood bits, ½"-1½", 14s., ⅞"-3", 19s. Stillson wrenches 6", 4s. 6d., 8", 6s., 10", 7s. 6d. Hand drills ¼", 10s. Breast ½", 27s. 6d. Drill chucks ½" No. 1 or No. 2 M.T., 11s. 6d. Superior, 18s. 3d. Lathe centres No. 1 M.T., 4s. 7d., No. 2 M.T., 6s. 6d., No. 3 M.T., 8s. 6d. H.S. tool bits, ¼", 1s. 6d., 5/16", 1s. 11d., ⅜", 2s. 3d. Sets H.S. drills No. 1-60, 50s. H.S. drills 29 different 1/16"-½", 70s. H.S. A-Z, 57s. Stands with each set. Micrometers, 1", 10s. Drill grinding jig to ½", 37s.—S. Grimshaw, 7, Hall Street, Manchester 18. Warehouse, Gorton Lane.

Wanted. Centec Miller or similar.—Clarke, 5, Gartmoor Gardens, Southfields, S.W.19.

Offers. Kennedy Power Saw with motor, little used.—Bentley, Ralphs Ride, Bracknell, Berks.

DICK SIMMONDS & CO.
5 South Road, Erith, Kent
Drawings and materials for our celebrated 0-4-0 Tank Loco "Hercules" in 7¼" Gauge. "AJAX" in 5" Gauge and "BEATRICE" in 3½" Gauge. We hold large stocks of castings for many "L.B.S.C." Locos at keen prices.
We are specialists in Boiler Constructions and we braze customers boilers.
LISTS FREE FOR S.A.E.

3⅜" "Zyto" Lathe, chucks, tools, etc., as new, £27.—Clarke, 9, Cuckmans Drive, St. Albans, Herts.

Burnerd 8" 4-jaw independent chuck with key, brand new, £9.—Wickenden, 8, High Road, Byfleet.

Warwick Lathe 3½" × 18" B.G.S.C., c/shaft, chucks, nearest £25.—Robinson, 8A, Pennsylvania Road, Exeter.

Wanted. Small motorised wood planer. Full details to—Morse, 8, Coles Lane, West Bromwich.

3½" × 28" Myford "M" B.G.S.C. lathe nearly new, ½ h.p. motor, 3- and 4-jaw chucks, etc. Offers or exchange for Rollei.—Metcalfe, 44, Bond Gardens, Wallington, Surrey.

Hor. Milling M/c, Flexispeed, table 11" × 3¼", arbor, collets, vice, good condition. £15.—Topping, 219, Byres Road, Glasgow.

Enlarger, electronic flashgun, numerous accessories value, £40, exchange for 3" equipped lathe.—Morgan, 24, Tycoch, Cwmbran, Mon.

"Besco" cramp folding machine and stand, as new, bends 18 s.w.g. material up to 26", cost £58, accept £27 10. D.C. converter, 230/240 volt to 24 volt, 7 amps., £6 10s. 2 h.p. motor, 400/3/50, 950 r.p.m., £9 10s.—Box No. 8683, Model Engineer Offices.

Myford 3½" 24" bed B.G.S.C., motorised on stand. 3- and 4-jaw chucks, collets, milling and parting attachments, cutters, spares, fittings. Room wanted, lot £70.—Owen, 4, Homelands Road, Sale, Cheshire.

3½" Granville Lathe with stand, c/shaft, 3-jaw chuck, accessories, little used, £32 o.n.o.—Brace, 18, Bessingby Road, Ruislip, Middx.

Zyto 3⅜" × 12" B.G.S.C. lathe, countershaft, 4" s.c. chuck, 4" ind. chuck, ½" tailstock chuck, change wheels, faceplate, etc. £35 o.n.o.—Turner, 42, Selbourne Avenue, Newmaw, Weybridge, Surrey.

Sale. Sentinel S.4, Clayton and Shuttleworth 7 h.p.s. and Foster 6 h.p.s. traction engines.—D. F. Knight, Old, Northants. Phone : Walgrave St. Peters 227.

3-Jaw S.C. Chuck, 10½" dia., good condition, offered in exchange for 4-jaw chuck 5-7" dia., or any similar equipment. All letters answered. Details to 34, Stroke Road, Stamshaw, Portsmouth.

MODELS AND FITTINGS

Wanted. Traction Engine for preservation, working order preferred. Price, details to—M. J. Saul, 100, Park Road, Ware Herts.

Part Finished 4' Cabin Cruiser, 30 c.c. Stuart, magneto, starter, twin screw, suitable radio control, £15. 10 c.c. racing car independent suspension, mag., and starter gear. Second car 10 c.c. needs completing, £20 two. S.A.E. details.—The Shack, St. Cenydd Road, Caerphilly, Glam.

Wish to Exchange for old locomotive still capable of steaming, B.S.A. 1,000 c.c. comb. 1937, mechanically good, requires smartening up, stored four years. Write, call—SCOTT, 73, Derbyshire Lane, Sheffield 8.

Partly Finished Dyak chassis, all cylinder castings, tender wheels, complete set drawings. Copies M.E. covering L.B.S.C.s constructional details available, £3 10s., postage extra. Stuart Turner Sun twin, without bedplate and lubricator, in very good condition, little used, £5, posrage extra. —LLOYD, Moor Road, Brinsley, Notts.

For Sale. New Stuart beam engine, built by engineer enthusiast. What offers?—Box No. 8680, MODEL ENGINEER Offices.

Quantity Gauge "O" Scale Track. Centre third rail on wood sleepers and battens. Walkers & Holtzapffel manufacture, straights, curves, turnouts, crossings, etc. Sample sent on receipt of 2s. 6d. P.O., returnable. Write—BM/TGPX, London, W.C.1.

CATALOGUES

Tool & Materials ... ... 9d.
L.B.S.C. Blueprint & Castings ... 1/-
Refunded on first 20/- order.

HANDRAIL KNOBS

"O" Gauge ... ... 2/9 doz.
1 in. ,, ... 3/- ,,
2½ in. ,, ... 3/3 ,,
3½ in. ,, ... 3/9 ,,
5 in. ,, ... 4/3 ,,

Overseas orders a speciality.

KENNION BROS. LTD.,
2, Railway Place, Hertford. Phone 2573

Exchange 1½" Traction Engine coal-fired, for 1" traction engine, preferred oil-fired. Photograph of engine available.—AYRES, 1, Cameron Avenue, Belgrave, Leicester.

Small Traction Boiler, unfinished, some fittings, £5.—LEWIS, 74, Burnthwaite Road, Knotty Ash, Liverpool.

Wanted. Gauge 1 or gauge 2 0-4-0 or 0-6-0 or similar steam locomotive tank or tender, internally fired (meths.) in good working order. Details and price to—LINDSAY, P.O. Box 97, Bradford, Yorkshire.

Sale. Two steam 4-4-0 locomotives for 2½" gauge, £6 and £4.—12, Kingsway, Penwortham, Preston, Lancs.

Exchange. 2½" Gauge slip-link, coal-fired, tender locomotive 0-6-0 by Bassett-Lowke, little used. For any 3½" gauge locomotive, repairable condition O.K. Write —ROBERTS, 12, Ragnall Avenue, Marston-Green, Birmingham, 33.

Wanted. 10¼" Locomotive sound working order boiler test report if available. Fullest particulars to—J. O. C. SAMUEL, Greywood, Burwood Park, Walton-on-Thames.

5" Gauge 4-6-4 Tank Locomotive must be sold. What offers?—Box No. 8685, MODEL ENGINEER Offices.

ELECTRICAL

A.C. Motors Self Start, induction 200/250 volts, 50 cycles, 1 phase, 1,425 r.p.m., ¼ h.p., £4 2s. 6d., 1/3 h.p., £4 19s. 6d., ½ h.p., £6 15s. Perfect and guaranteed. Carriage extra.—JOHNSON ENGINEERING COMPANY, 319, Kennington Road, S.E.11. Reliance 1412/3.

GENERAL

American and Canadian Readers
VIRGINIA CASTINGS by WILWAU
are in stock here. We also handle all books and magazines of Percival Marshall & Co.
List for S.A.E.
Avery L. McCune, 11 Everett Place, Maplewood, N.J.

Air Compressors, tanks and accessories at far below list, from £5 17s. 6d., TV and lighting generator from £15.—TEDDINGTON ENGINEERING CO. LTD., 29-31, High Street, Teddington, Middx. Tel.: Kingston 1193.

Spraying Handbook, 3s. 10d., post free. Paints, cellulose and allied spraying sundries. Catalogue, 3d.—LEONARD BROOKS, 25, Oak Road, Harold Wood, Romford.

Guaranteed ! Easy Home Constructed Refrigeration. Genuine domestic components. Not secondhand ice cream scrap. Modern hermetic G.E.C. units, gas, electric and oil silent unit. Everything for refrigeration. Complete specialists. Send s.a.e. for free illustrated "Sealed system" leaflet or 1s. for complete catalogue (refunded with first order).—BRAID BROS., 50, Birchwood Avenue, Hackbridge, Surrey. Phone : Wallington 9309.

Learn It As You Do It—We provide practical equipment combined with instruction in radio, television, electricity, mechanics, chemistry, photography, etc. Write for full details to—E.M.I. INSTITUTES, Dept. ME47, London, W.4.

Unowot Whiston's Sell. S.A.E. catalogue.—K. R. WHISTON (Dept. M.E.S.), New Mills, Stockport.

Watches, any make repaired (with guarantee), post confidently to—YOUNG & SON, 133, London Road, Chippenham, Wilts.

Bumble Bee & Busy Bee, 50 c.c. auxiljary engines by Edgar T. Westbury. Send s.a.e. for list of our super-castings and all accessories for these engines.—BRAID BROS., 50, Birchwood Avenue, Hackbridge, Surrey. Telephone : Wallington 9309.

Bronze Rods, 7/32", ¼", 9/32" hexagon, ¼" round, 1s. ft. Drawn brass angle ⅛" × ¼", 10' lots, 5s. each. 3½" gauge handrail knobs, 2s. 6d. doz. Carriage extra.—MCDONNELL, 55A, Alexandra Road, Wolverhampton.

Compressors for Sale. Twin piston with tank, 2½ cu. ft. per min., £4. Single cyl., £2. All types motors. S.A.E. for list. —WHEELHOUSE, 13, Bell Road, Hounslow. 'Phone : HOU 3501.

Work Wanted. Turning, capstan milling, grinding, shaping. Fully equipped works in heart of London. Single or long runs.—BELL & SMART, 48-50, Tottenham Street, W.1.

Build Your Own Refrigerator. Everything to make built-in or cabinet refrigerator. S.A.E. for sealed unit list and schematic diagram or 1s. (refundable) for 32 page catalogue including details of free 4 cu. ft. cabinet diagram offer. Hire purchase available.—WHEELHOUSE, 13, Bell Road, Hounslow. 'Phone : HOU 3501.

Light Precision Turning, Fitting and Assembly Work Wanted. Production, experimental or prototype and complete mechanisms. Prompt delivery, moderate charges.—CANONBURY ENGINEERING CO., 283, Essex Road, London, N.1. Can 6256.

Those Bigger Sections of B.D.M. steel: 1" × ⅜", 3s.; 1¼" × ⅜", 3s. 9d.; 1¼" × ½", 4s. 6d.; 2" × ⅜", 6s. 3d.; 1½" × 1", 5s. 6d.; 2" × 1", 8s. 3d.; 5" × ½", 9s. 6d.; 2" sq. 17s. 6d. per ft., plus postage. Over 200 sections in stock. S.A.E. for list.—B. J. HARRIS, The Cottage, Corngreaves Hall, Cradley Heath, Staffs.

Thermostats. Open type for air, with heavy silver contacts, will carry 15 amp at 205 volts to break contact. Set temperature 35 C. with adjusting screw, price 5s. post paid.—H. MIDDLETON, 639, Abbeydale Road, Sheffield, 7.

Illustrated Catalogue No. 13. Containing over 450 items of Government surplus and model radio control equipment, 2s. 2d. Refunded on purchase of goods, 2s. 6d. overseas seamail.—ARTHUR SALLIS RADIO CONTROL LTD., Department M.E., 93, North Road, Brighton.

For Sale. About 1,400 M.E.s 1907-50, some vols. complete. Offers to—Box No. 8659, MODEL ENGINEER Offices.

Aqualung and compressor equipment.—PRYCE, 157, Malden Road, Cheam.

Wanted. Eureka Clock. Delivery to British Isles address.—PRESCOTT, Box No. 1552, Capetown.

2s. 6d. Magazine Parcels. American, British, general interest.—6, Niddrie Road, Portobello, Edinburgh.

Firm in London E.7 area has capacity for production of accurately turned parts, ⅛"-⅝" bar size. Also small chuck work. Write —Box No. 8684, MODEL ENGINEER Offices.

Bound by Publishers. M.E. volumes 85 to 92, unbound 93 to 96, all perfect.—1, Colgrove, Welwyn Garden City, Herts.

Greenly Drawings. Locomotive designs in 5" and 7¼" gauge. State gauge required. List 6d.—66, Heston Road, Heston, Middx.

Model Engineers For Sale, unbound 1947 to 1955, complete except Nos. 2811 to 2818 inclusive. What offers?—BOX No. 8682, MODEL ENGINEER Offices.

Adept Lathe, six speeds, 4-jaw and tail-stock chuck, many extras, £8. Cross-tube vertical boiler, injector, feed pump 18" × 10". Compound single acting steam engine, high speed, ¾" × 1⅛" × 1" stroke, £10 or separate.—Box No. 8681, MODEL ENGINEER Offices.

As New. Very large stock of Mecanno about £65 value.—BRETTEN, Bridge Works, St. Germans, King's Lynn.

"Monitor" brazing blowlamp, £3. New chemical balance scales, complete, £3 10s. Clear Perspex, various, 30s. lot.—GREENWOOD, 6, Endsleigh Place, Plymouth.

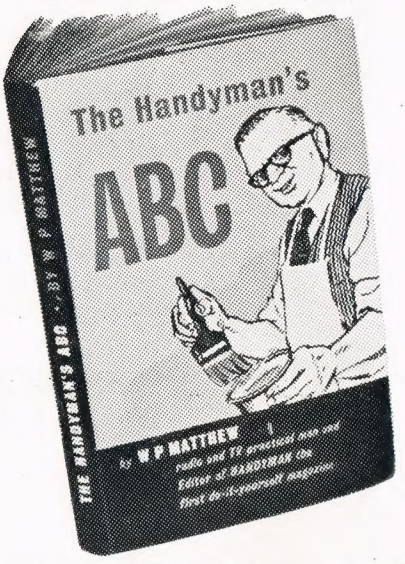
Organist, interested in live steam and model engineering generally, would like to correspond with those having similar interests.—J. H. BERRY, 20, Noakes Avenue, Chelmsford.

Printed in Great Britain for the Proprietors by ELECTRICAL PRESS LTD., Cordwallis Works, Maidenhead, Berks, and published by PERCIVAL MARSHALL & CO. LTD., 19-20, Noel Street, London, W.1.
Registered for transmission by Magazine Post to Canada including Newfoundland.

"A compendium of useful information"

The Handyman's ABC

by W. P. Matthew



HERE in a handy-sized booklet, is the cream of the late W. P. Matthew's extensive "know how," set out alphabetically for quick reference and supported by numerous drawings. The information given contains many money-saving tips and the material selected is based on the questions most frequently asked of the author when he was giving radio talks and demonstrations on TV. An indication of the scope of the book can be seen from the summary of contents.

6s.

Post 7d. (USA and Canada $1.50 post paid)

CONTENTS

Airer for the kitchen ceiling
Airing cupboard
Ants
Attic space utilisation

Box units
Bricquettes from coal dust
Burglar-proofing
Burst pipes

Carpet joining
Chimney on fire
Chimney smoking
Condensation
Cracks in plaster

Damp walls
Distemper
Drains
Draught proofing
Dry rot

Electric flex and cables
Emery sharpening board
Enamelling a bath

Fencing repairs
Fireplaces—repairing cracks in back
Fireplaces—replacing tiles
Floors of concrete—dusting
Floors and their renovation
Floors and their staining
Furniture polish you can make
Furniture and small repairs
Fuses, replacing

Gas ring cleaning
Glass and its replacement
Grease marks on wallpaper

Hammers
Hand basins and their repairs
Hard water
Hot water boiler

Ideas with cellophane tape
Indelible pencil marks
Ink stains
Inside decorations: planning a scheme
Insulating attics
Iodine stains
Iron and steel rust prevention
Iron mould stains
Japanese lacquer
Joining carpet

Kettle de-scaling
Kitchen shelves
Kitchen sink care
Kitchen sink gap sealing
Kitchen table covering
Knives and knife handles

Ladder care
Lagging pipes
Lath and plaster wall fixing
Leakage of gas
Leaded windows
Limed oak finish
Limewash
Lino laying and repairing
Locks and their care

Masking tapes
Measuring tools
Meter reading
Mildew
Mirrors
Mixing concrete
Moths
Mower maintenance

Nails
Natural wood finishes
Noise prevention
Noises in pipes
Nut and screw removal

Oiling and greasing around the house
Oilstone for sharpening
To sharpen a pocket knife
To sharpen a chisel
Overflowing cistern
Overflowing sinks

Paint: emulsion and distempers
Paint blistering
Hints on painting
The paint shield
Painting clean surfaces, framing, furniture, iron and steelwork, wood
Paint stripping
Paint quantities required
Paint rollers and their use

Paintwork: preparing for repainting; restoring the gloss; washing
Plastic tile laying
Plugging a wall
Putty

Quantities of materials
Quarry tile replacing

Roof gutters and pipes
Roofing defects
Rubber tile flooring
Rust

Sash cord replacing
Saws: types and tips
Screwdriver care
Screws
Sealing cracks and joints
Simple soldering
Squeaking stairs
Stair carpet laying

Table legs
Taps
Thermoplastic floor tiles
Tight and sticking doors
Tools: power driven

Varnishing
Vermiculite

Wallpaper hanging
Wax polishing a new floor
Woodworm and your furniture

Order direct from Percival Marshall on the form below

M.E.

DETACH ALONG DOTTED LINE

To Percival Marshall & Co. Ltd, 19-20 Noel Street, London, W1

Please send by return a copy of "The Handyman's ABC." I enclose remittance of 6s. 7d. to cover postage and packing. (USA and Canada $1.50).

FILL IN AND POST TODAY

NAME (Mr, Mrs, Miss).....

(PLEASE WRITE IN BLOCK LETTERS)

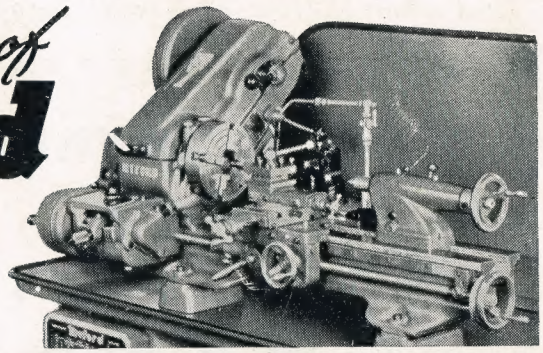
ADDRESS.....

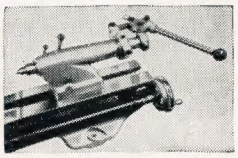
.....

(Overseas customers can use an International Postal Order)

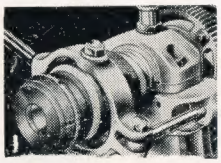
Double the usefulness of your Myford

With these handy attachments!

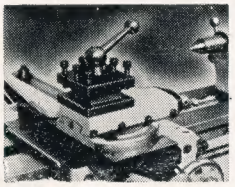




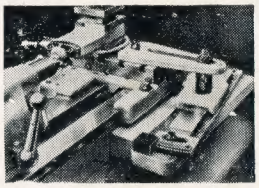
1640 Lever operated tailstock attachment



1611. Lever operated collet chuck: ⅜ in. capacity. Additional collets, style 1027



1410. Four tool turret, takes ⅝ in. sq. cutter bits



1629. Taper turning attachment, slide base 9 in. long, working length 6 in., angular movement 10° either side of zero

2A 1495. Dividing attachment (with two division plates)

MA68/1. Vertical slide, swivelling type

Many awkward jobs are within your easy reach, thanks to the range of over 50 Accessories provided by our factory. Careful thought, and research into the needs of the most exacting user, has produced a series of easily fitted, precision-made extras. Send to-day to DEPT. 10/42 for fullest details.

MYFORD ENGINEERING CO. LTD., Beeston, Notts., England Phone: Beeston 25-4222 Grams: Myford, Beeston, Notts

Myford

L.M.S. 4-6-2 Locomotive Castings

Duchess Class

½" Scale

Complete set of drawings	£2 5 0	Pony truck	7/- each
Frame steel, 2½ x 3/32	1/2 ft.	Tender wheel	1/4 each
Outside cylinders	17/6 each	Screw reverse frame	2/6 each
Outside motion plate	2/6 pair	Reverse steady bracket	1/2 each
Valve gear bracket	2/9 pair	Wheel splashers	2/3 each
Loco buffer beam	2/6 each	Cab sides	8/- pair
Tender buffer beam, front	3/- each	Engine footplate	5/- each
Tender buffer beam, rear	3/- each	Tender footplate	3/- each
Loco bogie equaliser	2/9 pair	Running plate brackets	2/6 set 4
Loco bogie pin stretcher	2/- each	Steps	2/- pair
Loco bogie stretcher	3/- each	Tender horn & spring	1/9 each
Loco bogie axleboxes	4/6 set 4	Tender axleboxes	10d. per in.
Loco main horns	1/3 each	Tender water filler	3/6 each
Loco main axleboxes	10d. per in.	Chimney	3/9 each
Loco main frame stretcher	2/- each	Petticoat pipe	5/6 each
Loco main frame stretcher for lubricator	2/- each	Dome	2/6 each
Bogie wheel	10½ each	Inner dome cover	2/6 each
Driving wheel	2/10 each	Smokebox door and ring	4/9 pair
Rear frame	10/6 each	Smokebox saddle	3/6 each
		Tender pump	6/6 each
		Axle drive pump	7/- each
		Eccentric strap	1/9 each
		Regulator	9/- each
		Dummy steam pipes	5/9 pair

All Prices plus Packing and Postage.

Bond's Model Catalogue, Price 2/-

Bond's Gear, Steam Fitting, Tool and Material Catalogue, Price 1/9

BOND'S O' EUSTON ROAD LTD.

357, Euston Road, London, N.W.1

Est. 1887. Phone: EUSton 5441-2

Follow the **FLUXITE** *way to Easy Soldering*

No. 11 *Keeping the bit hot*

When on a long job place bit just outside heating flame and occasionally apply FLUXITE. This will help prevent it from detinning. Don't dip the bit into the tin of FLUXITE—put a little aside in a spin tin lid for the purpose.

FLUXITE is the household word for a flux that is famous throughout the world for its absolute reliability. In factory, workshop and in the home FLUXITE has become indispensable. It has no equal. It has been the choice of Government works, leading manufacturers; engineers and mechanics for over 40 years.

FLUXITE

SIMPLIFIES *ALL* SOLDERING

Fluxite Limited, Bermondsey Street, London, S.E.1

GM.61